EPIDURAL VOLUME EXTENSION IN COMBINED SPINAL EPIDURAL ANAESTHESIA IN PREGNANT PATIENTS COMING FOR ELECTIVE CESAREAN SECTION WITH ROUTINE SPINAL ANAESTHESIA - A COMPARATIVE STUDY.

Dissertation submitted for

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APRIL 2015

CERTIFICATE

This is to certify that the dissertation entitled, "**EPIDURAL VOLUME EXTENSION IN COMBINED SPINAL EPIDURAL ANAESTHESIA IN PREGNANT PATIENTS COMING FOR ELECTIVE CESAREAN SECTION WITH ROUTINE SPINAL ANAESTHESIA - A COMPARATIVE STUDY**" submitted by Dr.C.VANITHA , in partial fulfillment for the award of the degree of Doctor of Medicine in Anaesthesiology by the Tamilnadu Dr. M.G.R Medical University, Chennai is a bonafide record of the work done by him in the INSTITUTE OF ANAESTHESIOLOGY & CRITICAL CARE, Madras Medical College, during the academic year 2012-2015.

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Place:

DECLARATION

I hereby declare that the dissertation entitled, "**EPIDURAL VOLUME EXTENSION IN COMBINED SPINAL EPIDURAL ANAESTHESIA IN PREGNANT PATIENTS COMING FOR ELECTIVE CESAREAN SECTION WITH ROUTINE SPINAL ANAESTHESIA - A COMPARATIVE STUDY**" has been prepared by me under the guidance of PROF. DR. CHANDRIKA, MD., Chief Anaesthesiologist, Institute of Anaesthesiology and Critical Care, Madras Medical College, Chennai, in partial fulfillment of the regulations for the award of the degree of M.D [Anaesthesiology], examination to be held in April 2015.

This study was conducted at Institute of obstretics and gynecology, Madras Medical College, Chennai.

I have not submitted this dissertation previously to any Journal or to any University for the award of any degree or diploma.

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ABBREVIATIONS

CSE	–	COMBINED SPINAL AND EPIDURAL
EVE	–	EPIDURAL VOLUME EXTENSION
INJ	–	INJECTION
IV	–	INTRAVENOUS
CSF	–	CEREBROSPINAL FLUID
MAC	–	MINIMAL ALVEOLAR CONCENTRATION
FRC	–	FUNCTIONAL RESIDUAL CAPACITY
LSCS	–	LOWER SEGMENT CESAREAN SECTION
MS,AS	–	MITRAL STENOSIS, AORTIC STENOSIS
ECG	–	ELECTROCARDIOGRAM
ICU	–	INTENSIVE CARE UNIT
MRI	–	MAGNETIC RESONANCE IMAGING
SPO2	–	ARTERIAL OXYGEN SATURATION
BP,PR	–	BLOOD PRESSURE, PULSE RATE
TURP	–	TRANS URETHRAL RESECTION OF PROSTATE
ASA	–	AMERICAN SOCEITY OF ANAESTHESIOLOGISTS
ML/MIN	–	MILILITERS/MINUTE

CONTENTS

EPIDURAL VOLUME EXTENSION IN COMBINED SPINAL EPIDURAL ANAESTHESIA IN PREGNANT PATIENTS COMING FOR ELECTIVE CESAREAN SECTION WITH ROUTINE SPINAL ANAESTHESIA- A COMPARATIVE STUDY

ABSTRACT

AIM: To evaluate the effects of Epidural volume extension with Normal saline given along with Hyperbaric bupivacaine in combined spinal epidural technique for parturients planned for elective cesarean section to achieve adequate anaesthesia with better hemodynamic stability and early reversal of motor blockade.

METHOD: 60 term parturients were enrolled in the study and were randomly allocated into one of the 2 groups comprising 30 in each. One group (group E) received epidural volume extension with 6mL of normal saline along with 5mg of 0.5% hyperbaric bupivacaine plus 25 mcg fentanyl and the other group (group C) received only spinal anesthesia with 10mg of 0.5% hyperbaric bupivacaine plus 25 mcg fentanyl. Haemodynamics, peak sensory block height, time of regression of sensory blockade, degree and duration of motor blockade, ephedrine consumption, neonatal scores,

nausea, vomiting, time to first analgesic supplement required were noted and compared between the two groups.

STATISTICAL ANALYSIS: Done using SPSS software version 17.0 using student T test.

RESULTS: Systolic blood pressures after the 20^{th} min of initiation of spinal blockade were significantly higher in Group E compared to Group C, till the 40^{th} min. (P values for the 20^{th}, 25^{th}, 30^{th} and 40^{th} min respectively were 0.001, <0.001, 0.002, 0.012). ephedrine consumption was significantly higher in group C (P 0.042). Motor blockade regressed sooner in group E compared to group C (P<0.001). Other monitored parameters were similar in both groups.

CONCLUSION: Epidural volume extension with normal saline in combined spinal epidural anaesthesia provides a hemodynamically stable anaesthesia with reduced duration of motor blockade without compromising the duration and quality of anaesthesia and with no adverse fetal effects, for elective cesarean section. These benefits are obtainable at a reduced dose of intrathecal local anaesthetic.

INTRODUCTION

Pregnancy is the most vital period in every women's life, in which delivery is the critical period risking the life of both mother and fetus. For every pregnant woman, pain during delivery continues to be a nightmare. Generally in very olden days, almost all parturientswere subjected to undergo normal vaginal delivery. Eventhough vaginal delivery is beneficial to the mother in many ways (decreased maternal morbidity, resumption of routine work earlier and less blood loss). In recent days, the incidence of cesarean deliveries has increased tremendously. There are some conditions or situations during which allowing the pregnant women to undergo normal vaginal delivery may be life threatening to either mother or fetus. The most common conditions are fetal distress, failure of progression of secondstageoflabor, malpresentations, uterineanomalies, cephalopelvic disproportion, etc.[3] In these situations, cesarean section plays a major role in the safe confinement of mother.

The word cesarean section means 'cutting the uterus and expelling the baby through the incision'. Never can a surgery be planned without Anaesthesia. ObstetricAnaesthesia is different in many ways from anaesthesia for non obstetric surgeries. In pregnant women, the

anaesthesiologists are responsible to take care of two lives simultaneously throughout the procedure. Hence special considerations aretaken even during planning the modalities of anaesthesia, pre operative assessment and intra operative monitoring. Hence regional anaesthesia has gained more popularity in obstetrics than general anaesthesia . Among regional techniques spinal anaesthesia is routinely practiced, but due to its definite duration and adverse effects ,other techniques have evolved. Epidural anaesthesia can provide prolonged duration of operative anaesthesia with less adverse effects but it may result in patchy blockade or catheter related problems.

Now Combined Spinal Epidural(CSE) anaesthesia provides advantages of both techniques,with minimal adverse effects as drug dosage used here would be nearly 50% less than that used for routine spinal anaesthesia. Failure rate of both techniques combined is only 0.16%.[(2)] but when used separately each technique had a failure rate of about 2-5%.[(2)].

This study is based on the principle of Epidural Volume Extension(EVE), which is a modification of CSE. Here a small volume of normal saline is used epidurally, aiming at rapidly increasing the level of sensory blockade with a low dose of intrathecal bupivacaine

administered. This normal saline produces a mechanical compression effect intrathecally, causing a more cephalad spread of the drug administered obtaining an adequate surgical anaesthesia with fewer complications.

AIM OF THE STUDY

The Aim of this study is to evaluate the effects of Epidural volume extension with Normal saline given along withIntrathecal Hyperbaric bupivacaine in combined spinal epidural technique for parturients planned for elective cesarean section to achieve adequate anaesthesia.

HISTORY OF OBSTETRIC ANAESTHESIA

Inception of obstetric anaesthesiawas not without any obstacles. In the 19th century, pain during delivery had been seen on a theological basis. Nullifying labor pain was considered a great sin[3]. Initially diethyl ether and chloroform were used to anaesthetize pregnant women during cesarean delivery. This form of general anaesthesia had higher rate of mortality and morbidity in both mother and fetus. In 1900 spinal cocaine was first used for cesarean section[3]. Since then spinal anaesthesia has become the most popular regional technique for patients coming for cesarean section,as spinal anaesthesia overcomes almost all of the complications seen during general anaesthesia.

ANATOMY OF VERTEBRAL COLUMN AND MENINGES[4]

Vertebral column is composed of 33 vertebra – 7 cervical, 12 thoracic , 5 lumbar, 5 sacral and 4 coccygeal vertebrae. Vertebral column gives protection to the spinal cord and at the same time permits movements of the trunk. Vertebral column is a curved structure but it is not a uniform smooth curve. The cervical and lumbar portion curves (convex anteriorly) are termed lordosis. The thoracic and sacral portion curves (concave anteriorly) are termed kyphosis.

Each vertebra has a vertebral body,pedicles,lamina,transverse process, superior and inferior articular facets and a spinous process. Between the adjacent vertebral bodies are the intervertebral discs,which are fibrocartilagenous elements, which bear the entire weight of the body and also permits flexion movement of vertebral column. The gap between the pedicles of adjacent vertebral bodies forms the intervertebral foramen,through which the spinal nerves exit the vertebral column from the spinal cord.

The 5 sacral vertebrae fuse into a single structure called the sacral bone. It has 4 pairs of anterior and 4 pairs of posterior sacral foramina,which allows the passage of anterior and posterior primary rami of upper 4 sacral nerves respectively.The distal part of sacrum consists of tha sacral hiatus which is covered by sacro-coccygeal ligament.

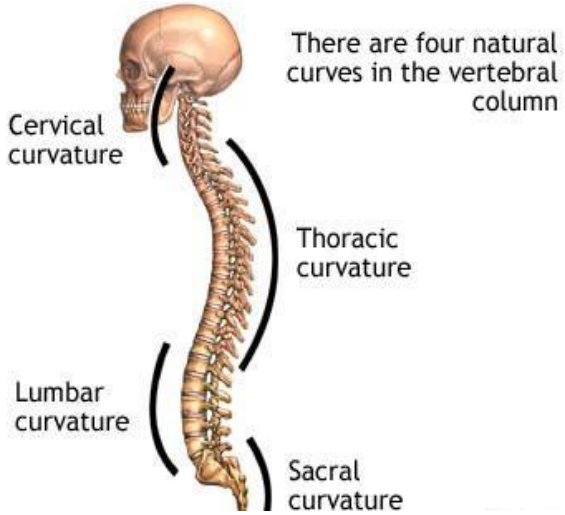

Fig 1. Normal curvatures of vertebral column (Image courtesy : Wikipedia)

ANATOMICAL CHANGES OF VERTEBRAL COLUMN IN PREGNANCY[4,5]

The two major changes in vertebral column of a pregnant women which is of main concern for an anaesthesiologists are the following

1. Shift of apex of thoracic kyphosis to a higher level

2. Exaggerated lumbar lordosis.

Fig 2. Exaggerated lumbar lordosis in pregnancy (Image courtesy: Wikipedia)

MENINGES[4]

Meninges cover the brain and spinal cord. It is composed of three layers namely duramater(pachymeninx) ,arachnoidmater and piamater(leptomeninges).The duramater is the outermost layer and piamater is the innermost layer. Spinal cord hangs freely within the duralsac.

The spinal dural sac extends from foramen magnum to s2 level of sacrum. Dural sac is composed of collagenous lamella and some elastin fibres. The fibrous strands run both circumferentially and longitudinally, but the longitudinal orientation is the predominant arrangement. The dura mater is thickest in the posterior midline, of which the lumbar part of the duramater is the thinnest.

The arachnoid mater and piamater are of common embryological origin and hence called together as leptomeninges. Both are delicate membranes with basal laminae and tight intercellular junctions and form physiologically active barrier.

The space between vertebral canal and dural sac is the epidural space and the space between arachnoidmater and piamater is the subarachnoid space where the cerebrospinal fluid circulates. Subdural space was considered a potential space between duramater and

arachnoid mater. However recent studies say that subdural space is actually a space between the cellular layers of arachnoid mater. The Ligamentum flavum is the strongest ligament which immediately covers the subarachnoid space. For Anaesthesiologists this forms the most important landmark for the identification of Epidural and Subarachnoid space.

ANATOMY OF EPIDURAL SPACE[2]

A vital space surrounding the dura,most commonly used by anaesthesiologists. Epidural space extends from the foramen magnum upto sacral hiatus.

BOUNDARIES

Anteriorly – posterior longitudinal ligaments

Laterally –pedicles and intervertebral foramina

Posteriorly – ligamentumflavum

CONTENTS OF THE SPACE

Nerve roots

Fat and areolar tissue

Lymphatics

Venous plexus of Batson

This epidural space is highly segmented and not uniform in size, hence spread of drugs injected epidurally were unpredictable and may result in patchy blockade.[2].

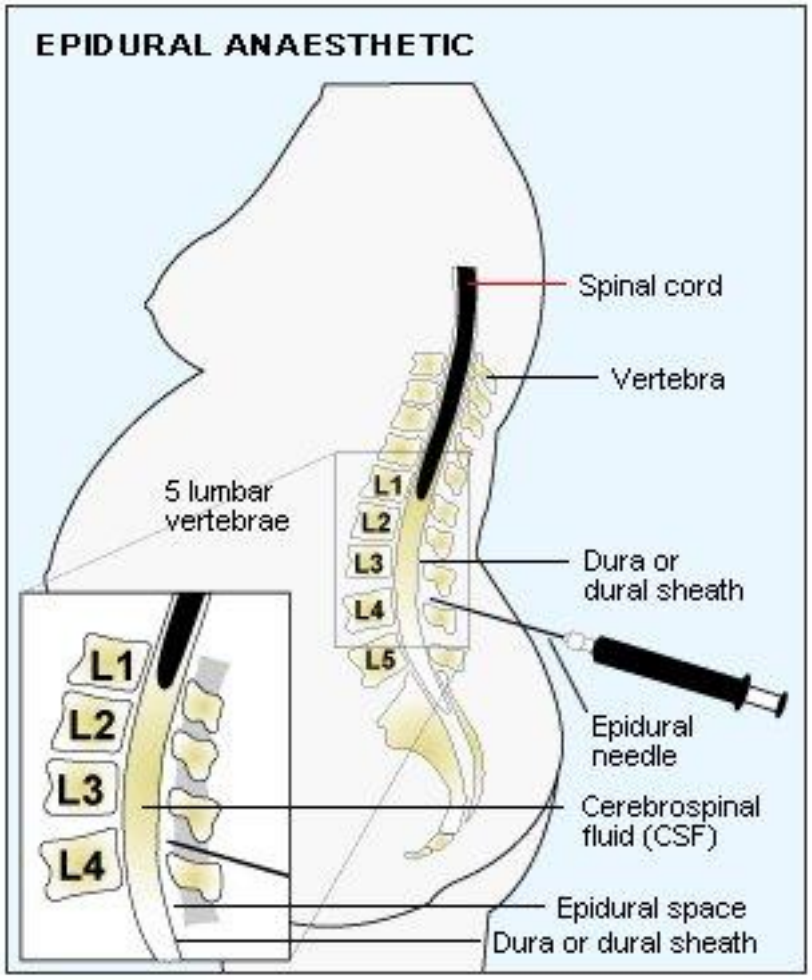

Fig 3. Anatomy of epidural space in pregnant woman (Image courtesy: frca.co.uk)

This picture shows the level of termination of spinal cord, epidural space and subarachnoid space

CHANGES IN PREGNANCY[5]:

In pregnancy, compression of inferior vena cava by gravid uterus results in increased flow of blood through the epidural venous plexus, as these are the collateral route for blood from lower half of body. Due to engorgement of epidural venous plexus, the subarachnoid space becomes compressed.

Moreover, there will be increased intra abdominal pressure in pregnancy, which is transmitted to epidural space via intervertebral foramina. Hence the pressure in the Epidural space is positive while it is negative in most of the non pregnant women. This makes the identification of Epidural space . So finding of Epidural space should be done cautiously.

This leads to further compression and narrowing of subarachnoid space. This leads to higher sensory blockade achieved with lower doses of spinal local anaesthetics.

DYNAMICS OF CSF FLOW[4]

Cerebrospinal fluid (CSF) is formed in the choroid plexus of cerebral lateral ventricles. From lateral ventricles, CSF flows to third ventricle through foramen of munro. From there it flows to fourth ventricle through aqueduct of sylvius. Then it circulates into the basal cisterns, convexities of brain and spinal subarachnoid space by passing out through foramen of lushka and foramen of magendie. Some CSF passes from fourth ventricle to spinal canal. About 500 mL of CSF is formed daily. Major part is present in the cranial subarachnoid space. The volume of CSF in spinal subarachnoid space greatly determines the spread of local anaesthetics injected intrathecally. The CSF is drained into the cerebral venous sinuses through arachnoid granulations.

CHANGES IN PREGNANCY[4]

CSF flow dynamics remain unaltered in pregnancy.

UTEROPLACENTAL BLOOD FLOW[8]

Growth and wellbeing of the developing fetus depends upon adequate uteroplacental blood flow. The main blood supply to the uterus is derived from uterine artery, a branch of internal iliac artery. Uterine artery branches into arcuate arteries. These arcuate arteries gives rise to radial arteries in the myometrium, which enters the endometrium and forms spiral arteries which are convoluted. During the placental formation, the spiral arteries are invaded by the trophoblasts, which causes the loss of smooth muscles in those arteries and makes them non responsive to vasoconstrictors. Non pregnant uterus receives a meager blood supply when compared to vital organs. But gravid uterus receives more and more blood supply as the pregnancy progresses approaching around 600mL/min during term. Uterus of non pregnant women exhibit autoregulation of blood flow. Blood flow remains stable even when blood pressure fluctuates. But in gravid uterus, the spiral arteries dilate tremendously and hence the autoregulating capacity is lost. Uteroplacental perfusion decreases whenever hypotension occurs (uteroplacental perfusion becomes pressure passive)[8]. Labor induced pain and stress increases the circulating levels of catecholamines, thereby decreases the uteroplacental blood flow. Neuraxial blockade

induced hypotension also reduces uteroplacental blood flow. But when hemodynamic stability is maintained during neuraxial blockade, it has advantage in maintaining uteroplacental blood flow , as stress is reduced in neuraxial blockade due to adequate pain relief and hence reduced catecholamine release. Dose of local anaesthetics within the clinical limits does not have any effect on uteroplacental blood flow. But large doses of local anaesthetics can induce intense vasoconstriction, thereby decreasing uteroplacental blood flow.Intrathecalopioids increase the uterine tone and thereby decreases the placental blood flow. This results in bradycardia in the fetus. But this effect of opioid is controversial. Further studies in epidural fentanyl and morphine found to have no effect on uterine blood flow in pregnant women. But meperidine and sufentanil given intrathecally has been found to decrease the blood flow to gravid uterus. Intravenous anaesthetics cause hypotension during induction which can reduce the uteroplacental perfusion. Moreover, large amount of catecholamines released during intubation response also reduces uteroplacental perfusion to a great extent. Volatile anaesthetics increase uteroplacental blood flow when used in more than 2 MAC concentration. This is due to the decrease in uterine tone by volatile anaesthetics. Positive pressure ventilation during general anaesthesia reduces the cardiac output due to increase in intrathoracic pressure. This

results in reduction of uteroplacental blood flow. Hence hyperventilation should be avoided in pregnant women undergoing general anaesthesia.

MODES OF ANAESTHESIA FOR CESAREAN DELIVERY

GENERAL ANAESTHESIA[2,3]

Due to the physiological and anatomical changes during pregnancy in airway(pharyngolaryngeal edema, reduced FRC, increased risk of bleeding) and gastrointestinal system(decreased gastric motility and increased risk of aspiration), general anaesthesia poses increased risk of airway problems and oxygenation of the patient. Moreover, use of multiple drugs such as opioids and volatile anaestheticsresult in adverse fetal effects.Inspite of all these disadvantages, even now, general anaesthesia has become mandatory in some special situations like ecclampsia, placental abruption and vasa previa, which may result in more hemodynamic instability in the mother resulting in reduced uteroplacental perfusion and consequently, fetal hypoxia.

SPINAL ANAESTHESIA[2,3]

Since spinal anaesthesia avoids airway manipulation and its attendant complications, it has become very popular nowadays for cesarean delivery. During spinal anaesthesia, patient will be aware of her delivery, bleeding chances are less and polypharmacy is avoided. Other advantages of spinal anaesthesia are rapid onset of reliable and dense blockade, minimal transfer of drug to the fetus, less risk of local anaesthetic toxicity and promotes earlier breast feeding. But even this spinal anaesthesia is not without any adverse effects. Some of the adverse effects are hypotension, post dural puncture headache and rare neurologic complications . For a satisfactory anaesthesia, a sensory level of T4 should be present for a cesarean delivery. Such high level results in profound hypotension and prolonged motor blockade. Moreover pregnant women depends entirely on the sympathetic nervous system integrity for their haemodynamic stability. Thus the pharmacological therapeutic sympathectomy results in profound hypotension than when compared to that of non pregnant women.

In order to overcome these two major adverse effects of sub arachnoid blockade, technique of epidural anaesthesia has come into practice.

Factors affecting the height of spinal blockade[2]:

Spinal anaesthetic block height is influenced by several factors which can be classified into controllable and not controllable.

Factors controllable

Local anaesthetic dose

Local anaestheticbaricity

Injection site along the neuraxis

Patient posture

Factors cannot be controlled

CSF volume (lumbosacral)

CSF density

EPIDURAL ANAESTHESIA[2,3]

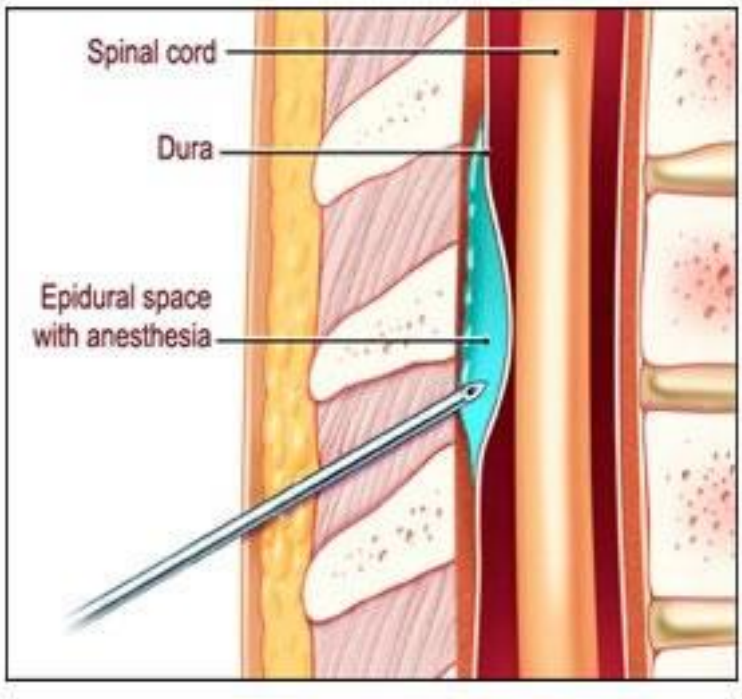

Fig 4. Epidural injection (Image courtesy: frca.co.uk)

In epidural anaesthesia for cesarean delivery, usually a catheter is placed inside the epidural space, through which both operative anaesthesia and post operative pain relief can be provided. Since the local anaesthetic is delivered outside the duramater, it has to cross the dura and arachnoid into the CSF and then into the nerve roots to exert its effect. So the onset of sympathetic blockade is gradual and less severe compared to that of spinal anaesthesia. so the severity of hypotension is reduced in this technique. But here, the onset of blockade is slower. The requirement of total amount of local anaesthetic is very high to achieve

a sensory blockade similar to that of spinal anaesthesia. So chances of local anaesthetic toxicity is high. Catheter related problems like occlusion, migration (intrathecally or intravascularly), kinking may pose a great problem for anaesthetic supplementation during intra operative period.

Complications of Epidural anaesthesia[(2)]:

Inadvertent intravascular injection

Accidental subarachnoid injection

Neurological injury

COMBINED SPINAL EPIDURAL ANAESTHESIA

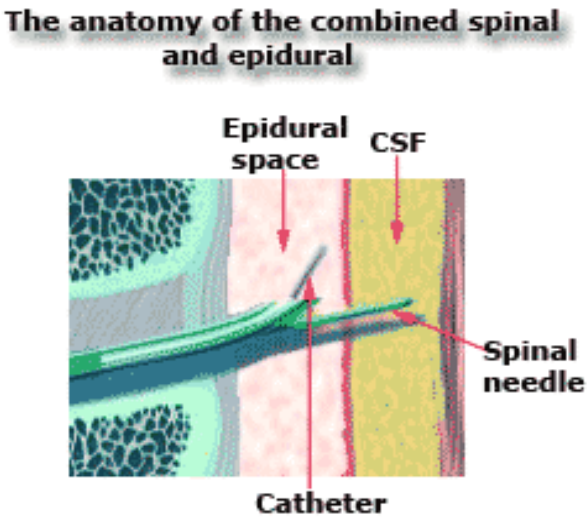

Fig 5. Depiction of CSE- needle through needle technique(Image courtesy: frca.co.uk)

Hence in recent days a new technique is gradually becoming very popular after 1987. In 1981,Brownridge suggested the application of CSE in LSCS.In 1984,Carrie described the method of needle through needle technique. This method combines the advantages of both spinal and epidural techniques.There are several methods in performing CSE.

Single pass method – not used nowadays

Needle through needle

Needle through needle with backeye

Needle through needle with a locking device – method used in this study

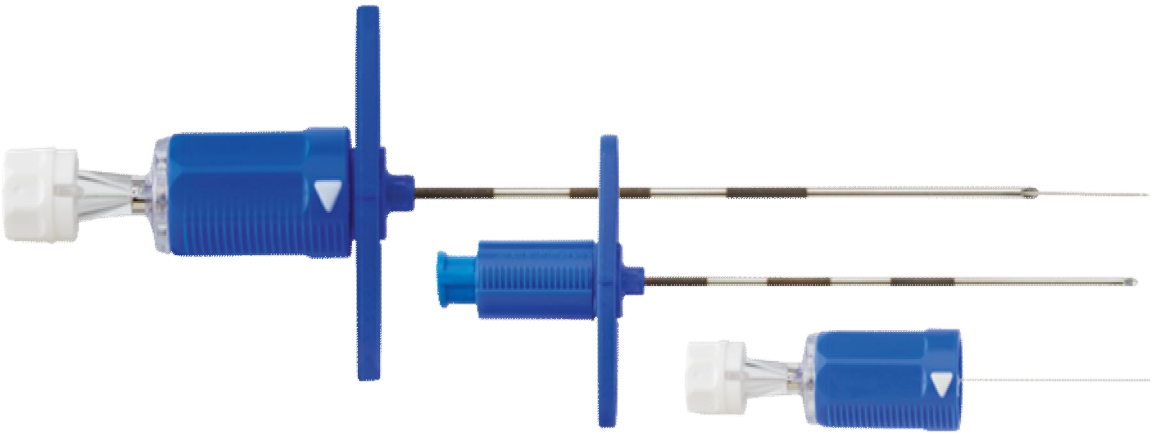

Fig 6.Portex combined spinal epidural needle set (Image courtesy: portexsafety.com)

Fig 7. Tip of CSE needle through needle set(Image courtesy: weiku.com)

Two needles through two different interspaces

Two needles through the same interspace

Combined needles

Here the technique is performed by using a needle through needle method i.e first epidural space is identified by using an epidural needle then in the same space a smaller gauge spinal needle is inserted through the epidural needle, after the flow of CSF is seen, subarachnoid blockade is given following which the spinal needle is removed and epidural catheter is inserted through the same space. The major advantage of this technique is the amount of local anaesthetic given spinally can be reduced by 50-55% of normal amount but the desired level can be achieved by giving either normal saline(pressure effect) or local anaesthetic through the epidural catheter. Minimal amount of opioid additives can be used intrathecallyto improve the quality of blockade without any adverse effects to the fetus in uterus. As the amount of local anaesthetic used for spinal anaesthesia is reduced to half, most deleterious adverse effects like hypotension and unwanted prolonged motor blockade can be avoided[3].

Other advantages of this newer methods are

1. Failure rate is almost nil because even if one method fails we can stil provide adequate operative anaesthesia through the other method.

2. Generally pregnant women will be slightly edematous and obese when compared with normal ones, hence this strong epidural needle acts

as an introducer to spinal needle ,hence we get a good control for needle insertion.

3. Presence of indwelling epidural catheter can be utilized for providing a good quality post operative pain relief in the immediate post operative period.

DISADVANTAGES OF COMBINED SPINAL EPIDURAL TECHNIQUE[(2)]

1. Technically difficult

2. Increased incidence of accidental postdural puncture headache

3. Not suitable for emergency situations

CONTRAINDICATIONS FOR REGIONAL ANAESTHESIA[(2)]

Patients refusal (The absolute contraindication)

Skin or soft tissue infection at the site of entry

Intrinsic and idiopathic coagulapathy

Patients on anticoagulant treatment

Stenotic Cardiac lesions (Mitral stenosis , Aortic stenosis)

Raised intracranial tension

EFFECTS OF NEURAXIAL BLOCKADE ON VARIOUS SYSTEMS[2]

CARDIOVASCULAR SYSTEM

Neuraxial blockade techniques are known for their sympathectomy, which entirely depends on the height of the block, CVS symptoms are more because of sympathectomy induced bradycardia and hypotension. Both arterial and venous dilatation occurs, but as much of our blood is pooled in the venous system, venodilatation is responsible for the hypotension.

In case of high level of blockade, bradycardia is due to the blockade of cardioacceleratorfibres (T1 to T4). To treat the effects of sympathectomy, a mixed adrenergic agonist such as ephedrine is more commonly recommended and found to be effective.

RESPIRATORY SYSTEM[2]

Effects on respiratory system is most commonly due to the paralysis of respiratory muscles during neuraxial blockade.

Tidal volume is not altered, but a minimal decrement in vital capacity is observed in higher blockade. Greater decrements in peak

expiratory pressure was seen in pregnant women given lignocaine during cesarean section than when bupivacaine is given.

Usually inspiratory muscles which are active in respiration are not affected by spinal blockade in normal patients. Passive expiratory muscles are more commonly involved. Hence caution should be there while giving neuraxial blockade in a respiratory compromised patients.

GASTROINTESTINAL SYSTEM[(2)]

Effects on GIT is due to hyperperistalsis in gut due to vagal action which is unopposed by sympathetic system, producing nausea and vomiting in about 20% of patients. This contracted gut provides a good surgical exposure of visceral organs. Vomiting due to hyperperistalsis can be effectively treated with inj.atropine IV.

Post operative epidural analgesia maintains the mucosal P^H at a higher range, thereby serves as a mucosal barrier in post operative period.

RENAL SYSTEM[2]

Due to the wide range of auto regulation, renal blood flow is not affected significantly in the patients under regional anaesthesia. The main concern is about the prolonged urinary retention post operatively. This side effect is not an issue as parturients were already catheterized for cesarean section.

PHARMACOLOGY OF BUPIVACAINE[1,7]

Local anaesthestics are classified mainly into two types:

1. Amino-esters (eg: procaine)

2. Amino-amides (eg: bupivacine)

Bupivacaine was first synthesized in 1957 by Ekenstam ,but it was used clinically only in 1963. Clinical form of bupivacaine now in use is a racemic mixture of both ‘S’and ‘R’ forms in proportionally equal quantities. It is metabolized by hepatic microsomal enzymes.

PHYSICO-CHEMICAL PROPERTIES[1]

Molecular weight: 288

pKb : 8.2

Lipid solubility :28

Percentage of plasma protein binding :96

T1/2 : 210 mins

Clearance :8.3l/min

F/M(fetal-maternal) ratio: 0.2-0.4

CHEMICAL STRUCTURE

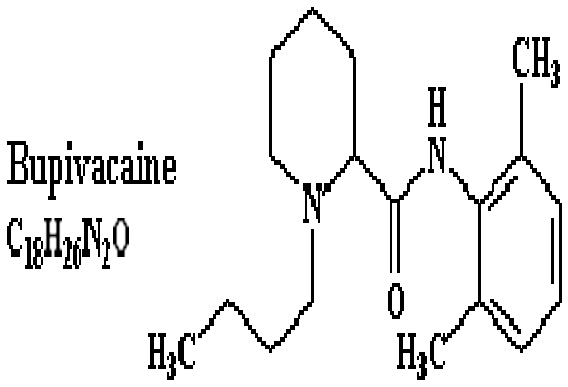

Fig 8. Structure of Bupivacaine (Image courtesy: Wikipedia)

MECHANISM OF ACTION

Similar to all other local anaesthetics,bupivacaine also causes inhibition of Na channels in nerve membrane.

It decreases the cell membrane permeability to sodium ions .Thereby preventing depolarization of cell membrane and blockade of Nerve conduction.

Permeability of resting membrane to K ions and Na ions are also reduced by bupivacaine and therefore it also has a stabilizing action on all excitable membranes.

PREPARATION

Available as 0.5%,0.25% solutions in 20ml,10ml vials , respectively Dextrose 80mg added with 0.5% bupivacaine(hyperbaric),4ml ampoules used for intrathecal injection.

USES

Central neuraxial blockade – various sensations such as pain,touch,temperature,sympathetictone,motor power are blocked.

Peripheral nerve blocks – blocks the major nerve trunk in that region ,anaesthetizing the areas supplied by them.

PHARMACOKINETICS[4]

Absorption from the site of injection is rapid by three main ways bulkflow, diffusion to its site of action and vascular uptake. Its duration of action is about 360 to 720 mins and the peak concentration is reached within 5-30 mins of administration. Metabolism is by dealkylation and aromatic hydroxylation which occurs in liver and excretion is through kidneys ,only 5% is excreted in unchanged form and remaining are excreted as metabolites.

MAXIMAL DOSAGE

The maximal dose of bupivacaine is 2.5mg/kg body weight. Ususal concentration used is between 0.0625%,0.125%.0.25% and 0.5%. 0.75% is banned by FDA. Not used in obstetrics because of increased risk of Cardiotoxicity. It has been found mixing with adrenaline had no effect on its duration of action.

COMPLICATIONS

Bupivacaine is a long acting local anaesthetic with a slower onset and it is Four times highly potent than lignocaine. It produces a more denser sensory blockade than motor blockade. Its systemic toxicity produces both CVS and CNS effects.

EFFECTS ON CARDIOVASCULAR SYSTEM[4]

Effects on Cardio Vascular System is mainly due to its high lipid solubility, it acts on the myocardium and interferes with the automaticity and contractility of the heart, it slows down the conduction of cardiac action potential resulting in ECG changes like prolonged PR and QT intervals. Conduction disturbances such as re-entrant phenomenon,atrial and ventricular arrhythmias are more common. Of the two stereotypes , R-enantiomer is more toxic.Moreover the cardiotoxic effects of

bupivacaine is comparatively higher in pregnancy. Because it enters Sodium channels Faster and exits slowly.

EFFECTS ON CENTRAL NERVOUS SYSTEM[4]

As the plasma concentration of the drug slowly increases,it produces a wide range of symptoms with minimal concentrations producing circumoral numbness, metallic taste slowly progessing to tinnitus,dizziness,confusion,slurred speech and finally convulsions in larger doses .

CONTRAINDICATIONS

Amide local anaesthetic hypersensitivity

Total intravenous regional anaesthesia

PHARMACOLOGY OF FENTANYL[4,7]

Fentanyl is a synthetic opioid. It is a derivative of phenylpiperidine. It is a congener of meperidine. This highly lipid soluble opioid is 75 to 125 times more potent analgesic than morphine. Since the drug is highly lipophilic, it has a rapid onset and short duration of action. But as the volume of distribution is large, its elimination half time is prolonged.

Fentanyl is highly protein bound (79 to 87%) .

CHEMICAL STRUCTURE

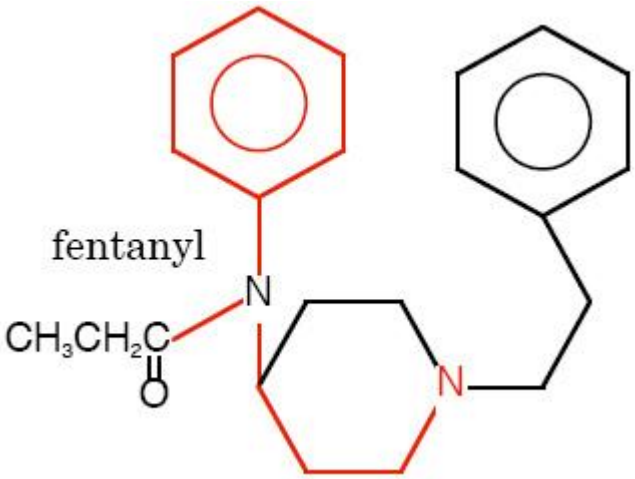

Fig 9.Stucture of fentanyl (Image courtesy: frca.co.uk)

METABOLISM

Fentanyl is metabolized in the liver by N-demethylation resulting in the formation of its major metabolite Nor fentanyl. The pharmacologic activity of nor-fentanyl is negligible. Fentanyl is also excreted unmetabolised in urine, but in a very little amount (<10%).

USES

1. Fentanyl is used as a pre-emptive analgesic and to blunt the intubation response.

2. As a adjuvant to local anaesthetic given either intrathecally or epidurally.

3. To provide post operative pain relief in ICU patients

NEURAXIAL FENTANYL

Intrathecal fentanyl produces rapid and intense analgesia, it has been used for labor analgesia and as an adjuvant to local anaesthetic for LSCS and other lower limb surgeries done under spinal anaesthesia. It improves the quality of spinal blockade . The maximal analgesic benefit is achieved with 25mcg of intrathecal fentanyl. This small intrathecal dose caries less side effects and can be used safely.

ADVERSE EFFECTS[2,4]

1. Pruritis
2. Nausea and vomiting
3. Urinary retention
4. Respiratory depression (in high doses)
5. Sedation
6. CNS excitation
7. Viral reactivation
8. Sexual and ocular dysfunction
9. Thermoregulatory dysfunction
10. Water retention

LOCAL ANAESTHETIC DOSE REQUIREMENTS IN PREGNANCY[5]:

Local anaesthetic dose requirement is 25% lower in pregnant women compared to non pregnant patients. Factors responsible for this reduced dose requirement are:

1. Decrease in CSF volume in Lumbosacral region due to inferior vena cava compression by the gravid uterus and diversion of blood flow through the collateral vertebral venous plexus.

2. Increase in neural sensitivity to local anaesthetics due to CSF alkalosis, increased progesterone levels and increase in the endorphin levels in the blood.

3. Exaggerated lumbar lordosis producing a natural head down tilt in lateral position makes the local anaesthetic spread favourably in cephalad direction.

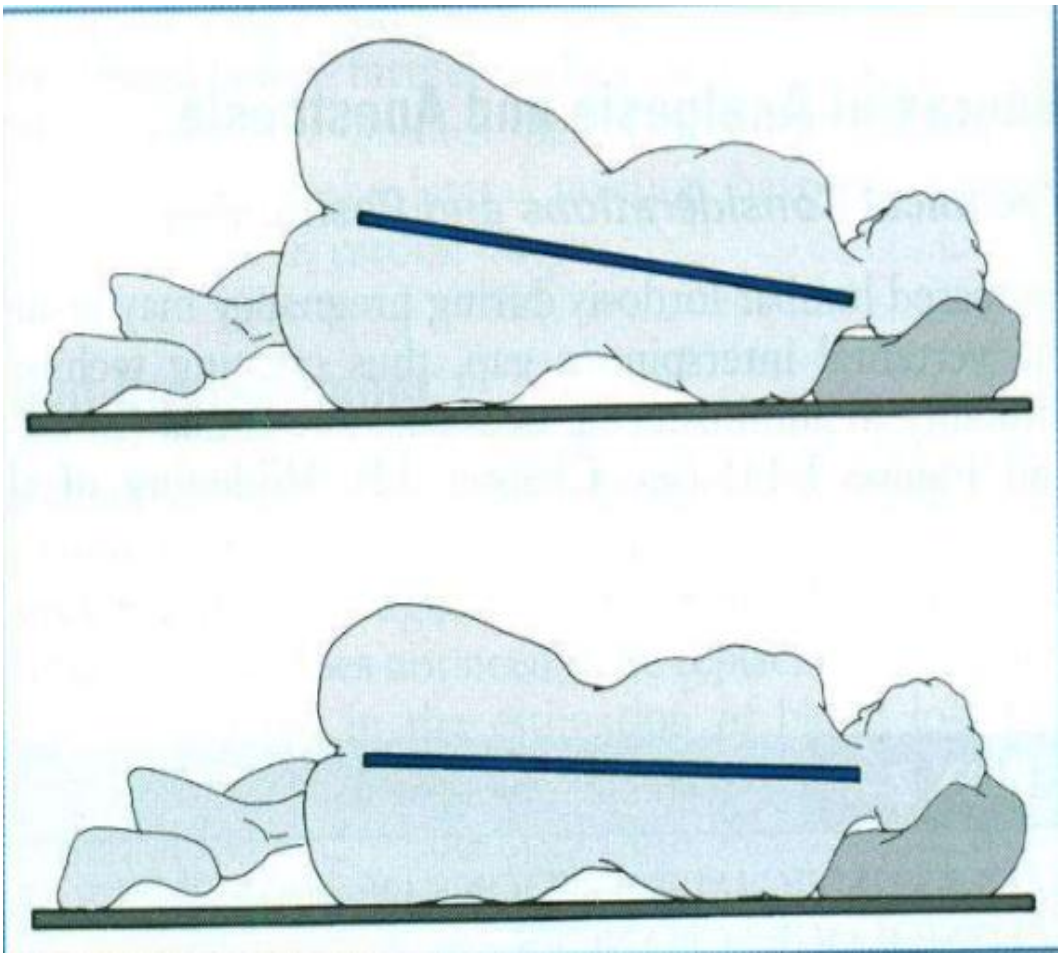

Fig 10. Head down tilt of vertebral column in lateral position in comparison to normal(Image courtesy: quizlet.com)

4. Apex of the thoracic kyphosis is at a higher level during pregnancy.

Inspite of all these above mentioned factors, the epidural dosage requirements remain the same both in pregnant and non pregnant women.

Pharmacokinetics and pharmacodynamics of bupivacaine are not altered during pregnancy, because the bound and unbound fractions remain the same[(1)].

REVIEW OF LITERATURE

1) LUMBOSACRAL CSF VOLUME IS THE PRIMARY DETERMINANT OF SENSORY BLOCK EXTENT AND DURATION OF SPINAL ANESTHESIA[11]

Anesthesiology, 1998 Jul;89(1):24-9

Carpenter RL et al

This study had been done to show that the lumbosacral CSF volume in each individual determines the sensory block extent and anesthesia duration. Multiple factors have been considered to affect the extent of spinal blockade. In this study, 50mg of hyperbaric lignocaine has been given intrathecally to 10 volunteers and the procedure is standardized to avoid confounding factors. Level of sensory blockade, duration of sensory blockade and duration of motor blockade were assessed. CSF volume at various levels of vertebrae is measured using axial MRI at 8mm intervals.in conclusion they found that the CSF volume changes in lumbosacral region is considered to be an important factor affecting the spread of spinal anaesthesia.

2) EFFECTS OF EPIDURAL INJECTION ON SPINAL BLOCK DURING COMBINED SPINAL AND EPIDURAL ANESTHESIA FOR CESAREAN DELIVERY[12]

RegAnesth Pain Med 2000 Nov-Dec; 25(6):591-5

Choi DH et el;

In this study, researchers have compared the effect of epidural injection of saline and hyperbaric bupivacaine on subarachnoid block. 66 pregnant women were planned for elective lower segment cesarean section were randomly allocated into three groups. Group one (n=21) received spinal anaesthesia with 8mg of 0.5% hyperbaric bupivacaine. Group two (n=21) received epidural injection of 10mL of normal saline in addition to intrathecal injection of 8mg of 0.5% hyperbaric bupivacaine. Group three (n=24) received epidural injection of 10mL of 0.25% bupivacaine along with intrathecal 8mg of 0.5% hyperbaric bupivacaine.

Parameters monitored in these 3 groups of pregnant women were:

-Maximal level of sensory blockade

-Time to reach the maximal sensory level

-Level of motor blockade

-Degree of muscle relaxation

In group one parturients, adequate surgical analgesia was not achieved. In group two parturients, sensory level achieved was higher compared to group one, but quality of block was inadequate. In group three parturients, higher level of sensory blockade was achieved and block quality was good compared to that of other groups. The maximal sensory level reached in groups two and three were similar.In our Study 5mg Bupivacaine intrathecally with Fentanyl 25mcg Resulted in adequate level of sensory and motor blockade.

3) INFLUENCE OF LUMBOSACRAL CEREBROSPINAL FLUID DENSITY, VELOCITY AND VOLUME ON EXTENT AND DURATION OF PLAIN BUPIVACAINE SPINAL ANESTHESIA[15]

Anesthesiology 2004 Jan;100(1):106-14

Higuchi H et al

This study was conducted to determine how the extent and duration of spinal anesthesia with plain bupivacaine was influenced by the lumbosacral CSF volume, density and velocity. 41 patients who were posted for orthopaedic surgery under spinal anaesthesia were

enrolled in the study. The volume of lumbosacral CSF was assessed using axial MRI. Phase contrast MRI was used to assess CSF velocity. CSF sample obtained just before giving plain bupivacaine in the subarachnoid space was used to find out the density of CSF. 3mL of plain bupivacaine was used for spinal anesthesia. Statistical analysis of the study showed that there was an inverse relationship between sensory block height and lumbosacral CSF volume. There was also an inverse relation between CSF velocity snd duration of motor blockade.

4) THE INFLUENCE OF LUMBOSACRAL CEREBROSPINAL FLUID VOLUME ON EXTENT AND DURATION OF HYPERBARIC BUPIVACAINE SPINAL ANESTHESIA: A COMPARISON BETWEEN SEATED AND LATERAL DECUBITUS INJECTION POSITIONS[16]

AnesthAnalg 2005 Aug;101(2):555-60

Higuchi H et al

In this study, 74 patients posted for orthopaedic and urogenital surgeries under spinal anesthesia were selected. Their lumbosacral CSF volumes were determined using axial MRI. These patients were then randomly allocated into one of the two groups namely group L (lateral) and group S (seated). Spinal anesthesia was given with 3mL of 0.5%

hyperbaric bupivacaine. Group L patients were turned supine immediately after spinal injection, whereas patients in group S were placed supine after being in seated position for 2 minutes after spinal injection. The study concludes that regardless of the patient position, spread of spinal anaesthesia with hyperbaric bupivacaine was influenced by lumbosacral CSF volume. But duration of spinal anesthesia with hyperbaric bupivacaine was influenced by CSF volume only in seated position.

5) COMBINED SPINAL EPIDURAL ANAESTHESIA USING EPIDURAL VOLUME EXTENSION LEADS TO FASTER MOTOR RECOVERY AFTER ELECTIVE CESAREAN DELIVERY[18]

AnesthAnalg 2004 Mar; 98(3):810-4

Lew E et el;

In this study epidural volume extension was used in combined spinal epidural anaesthesia thereby reducing the dose of local anaesthetic (hyperbaric bupivacaine) given to pregnant women coming for planned cesarean delivery. A total of 62 ASA I & II pregnant women were allocated into two groups. One group (n=21) received routine subarachnoid blockade with 9mg of hyperbaric bupivacaine plus 10mcg

of fentanyl. Second group (n=31) received a smaller dose of hyperbaric bupivacaine(5mg) plus 10mcg of fentanyl intrathecally followed by epidural volume extension with 6mL of normal saline. Following parameters were observed:

-Maximal level of sensory block achieved

-Lowest blood pressure recorded

-Maximal level of motor blockade achieved

-Time of sensory and motor blockade regression

-Incidence of breakthrough pain

Results were statistically analysed and had been found that pregnant women who received epidural volume extension showed significantly rapid motor reversal than women who were not received epidural volume extension. The findings of this study correlated with the results of our study.

6) COMBINED LOW DOSE SPINAL EPIDURAL ANESTHESIA VS SINGLE SHOT SPINAL ANESTHESIA FOR ELECTIVE CESAREAN DELIVERY[13]

Int J ObstAnesth 2006 Jan;15(1):13-7

Choi DH et el;

In this study single shot subarachnoid block was compared with low dose combined spinal epidural anaesthesia. One group of parturients(n=50) received single shot spinal blockade with 9mg hyperbaric bupivacaine plus 20mcg fentanyl. Second group of parturients (n=50) received 10mL of 0.25% bupivacaine through epidural catheter following spinal anaesthesia with 6mg of hyperbaric bupivacaine plus 20mcg of fentanyl.

Following were the results obtained in this study:

Initially higher level of sensory blockade was achieved in group one.

Maximal level of sensory blockade achieved in both groups were similar.

Incidence of hypotension, nausea and vomiting were higher in group one compared to that in group two.

Recovery of motor blockade was faster in group two.

7) COMPARISON OF LOW DOSES OF HYPERBARIC BUPIVACAINE IN COMBINED SPINAL EPIDURAL ANESTHESIA FOR CESAREAN DELIVERY[17]

AnesthAnalg 2009 Nov;109(5):1600-5

Leo S et al

This study compares various doses of hyperbaric bupivacaine given intrathecally to pregnant women during combined spinal epidural anesthesia. This helps in finding out the minimum amount of drug required to produce adequate sensory blockade and decreased incidence of side effects.

60 women were divided into three groups. One group received 7mg of bupivacaine, second group of women received 8mg of bupivacaine and the third group of women received 9mg of bupivacaine. Women in all three groups received 100mcg of intrathecal morphine along with bupivacaine.

Statistical analysis showed that the maximum level of sensory blockade achieved vary among the 3 groups. Women in group 1 achieved a sensory level of T2, group two women achieved T1-T2 and women in group 3 achieved a sensory level of T1. Minimal level of

sensory blockade required for cesarean section is T4. Hence the smallest dose (7mg) of hyperbaric bupivacaine given in this study has been found to give adequate anesthesia for surgery with minimal local anaesthetic side effects.

8) COMBINED SPINAL EPIDURAL AND EPIDURAL VOLUME EXTENSION: INTERACTION OF PATIENT POSITION AND HYPERBARIC BUPIVACAINE[9]

J Anaesthesiology Clinical Pharmacology. 2011; Oct-Dec; 27(4):459-464

AshaTyogiet el;

In this study, researchers have compared Combined spinal epidural anaesthesia with epidural volume extension in sitting (n=28) and lateral (n=28) positions and also combined spinal epidural anaesthesia without epidural volume extension on sitting (n=28) and lateral(n=28) positions. This study had been done on parturients with uncomplicated gestation who were more than 37 weeks gestation and who had been planned for elective LSCS.

Following parameters were noted in both groups:

-Hemodynamics every 5 min

-Maximal sensory level achieved

-Time at which maximum sensory level was achieved

-Time to two segment regression from maximal sensory level

-Maximal level of motor blockade achieved

-Period at which maximal level of motor blockade was achieved

Statistical analysis was done using SPSS software version 11.0.

On observation, they found significant difference in maximal sensory level achieved. Time to reach maximal sensory level is shorter in combined spinal epidural anaesthesia with epidural volume extension given in lateral position compared to sitting position. Other parameters were found to be similar in both sitting and lateral positions. Among parturients who received combined spinal epidural anaesthesia without epidural volume extension in sitting and lateral positions, time taken for regression of sensory blockade was longer in lateral position group than in sitting position group. Time taken for achieving maximal sensory level is shorter in lateral position group compared to that in sitting

position group. Other parameters were similar in both groups. In conclusion, this study states that , to achieve a higher sensory level with epidural volume extension technique in combined spinal epidural anaesthesia, the technique must be carried out in lateral position. The findings of this study correlates with our study.

9) EFFECT OF EPIDURAL TOP UP TECHNIQUE WITH SALINE IN COMBINED SPINAL EPIDURAL ANESTHESIA: A PROSPECTIVE STUDY[19]

Turk J Med Sci 2011;41(4):603-608

MahmutDeniz GOKCE et el;

In this study 50 patients in the age group of 45 to 75 years who had been planned for transurethral resection of prostate under regional anesthesia were selected. These patients were randomly allocated into one of the two groups namely group S (epidural saline group) and group C (control- who received no epidural saline). Patients in group S received 10mL of epidural saline in addition to in addition to intrathecal hyperbaric bupivacaine (10mg). patients in group C received only intrathecal bupivacaine.

Hemodynamic variables, level of sensory blockade achieved and time of its regression, degree of motor blockade and time to its reversal were all studied. SPSS version 10.0 was used for statistical analysis. There was a significant difference in the maximal level of sensory block achieved between the two groups.patients who received epidural saline had higher sensory level than patients who did not have it. Sensory block regression, motor block reversal and hemodynamic parameters were found to be similar in both group of patients.

10) EPIDURAL VOLUME EXTENSION IN COMBINED SPINAL EPIDURAL ANESTHESIA FOR ELECTIVE CESAREAN SECTION: A RANDOMIZED CONTROLLED TRIAL[14]

Anaesthesia 2011, 66:341-347

C. Loubertet el;

In this study, 90 term parturients were randomly selected and allocated into 3 groups. Women in group 1 received spinal anesthesia with 7.5mg of 0.5% bupivacaine plus 25mcg of fentanyl. Women in group 2 received spinal anesthesia with 7.5mg of 0.5% bupivacaine plus 25mcg of fentanyl along with 5mL of epidural saline. Women in group 3 received spinal anesthesia with 10mg of 0.5% bupivacaine plus 25mcg of fentanyl. Following parameters were compared:

-Maximum height of sensory block achieved

-Time of maximal sensory blockade

-Level of motor blockade achieved

-Incidence of hypotension and ephedrine consumption

-Analgesic requirement for intra operative breakthrough pain

-Neonatal scores & nausea, vomiting.

Time at which maximal level of sensory blockade attained was earlier in group 2 than in other two groups. But the maximal height of sensory block achieved was similar in all 3 groups. Failure rate was lower in group 3, compared to groups 1 and 2. Incidentally they found that the level of motor blockade was lower in group 2 than in group 1 & 3. All other parameters like hypotension, ephedrine consumption were similar in all three groups. Incidence of side effects & neonatal scores were not significantly different among the 3 groups.

11) MINIMUM EFFECTIVE VOLUME OF NORMAL SALINE FOR EPIDURAL VOLUME EXTENSION[10]

J of Anesth Clinical Pharm 2014 Apr-Jun;30(2):228-232

AshaTyogiet el;

This study has been done on 17 patients(adult males, 18-60 years of age, ASA I & II) scheduled for surgery in lower limbs under combined spinal epidural anaesthesia and had inadequate spinal blockade (sensory level lower than T10, 10 min after intrathecal injection). Of the 23 patients enrolled in the study, 6 were excluded, as their spinal blockade were adequate.

The volume of normal saline injected in epidural space had been decided by using up and down sequential allocation method of Dixon and Massey. The minimum effective volume was represented by effective dose 50 (ED50).

An increase in sensory level by 2 dermatomes within 5 minutes of epidural saline injection was considered as success of epidural volume extension technique. Intra operative hemodynamics, maximum sensory level, dermatomal ascent caused by epidural volume extension,

maximum motor block at the time of epidural volume extension were noted in all patients.

Statistical analysis was done using Dixon and Massey formula.

The minimum effective volume of normal saline for epidural volume extension in non obstetric patient seems to be 7.4mL.

The minimum effective volume of Normal Saline for epidural volume extension in our Obstretric patients were 6 ml.

MATERIALS AND METHODS

This study was conducted at the Institute of obstetrics and gynecology, Madras medical college, Egmore, Chennai, for a period of three months, on 60 parturients of ASA physical status I and II posted for elective cesarean section.

This study was performed after getting approval from Ethics committee, Madras Medical College and on obtaining written informed consent from all the parturients subjected to this study.

STUDY DESIGN

Prospective, randomized controlled study.

GROUPS

The parturients were randomly divided into 2 groups (group C and group E), each containing 30 subjects.

GROUP C

Parturients allotted to this group received 10mg(2mL) of 0.5% hyperbaric bupivacaine along with 25mcg of fentanyl intrathecally.

GROUP E

Parturients allotted to this group received 5mg(1mL) of 0.5% hyperbaric bupivacaine along with 25mcg of fentanyl intrathecally, followed by 6mL of normal saline injected into the epidural space via epidural catheter.

CASE SELECTION

INCLUSION CRITERIA

- Age : 18years to 35years
- ASA : I,II
- Surgery : Elective lower segment cesarean section
- Who have given written informed consent

EXCLUSION CRITERIA

- Patients younger than 16 years of age
- Patients with pregnancy induced hypertension
- Patients with gestational age < 36 wks
- Patients in active labour and other emergency situations

- Patients with contraindications for regional anaesthesia

PRE ANAESTHETIC EVALUATION

Pregnant women selected for this study were evaluated thoroughly .

HISTORY

Any previous surgeries in the past

Any associated comorbid illnesses

Any drug allergies

Any complications during previous pregnancies

These information were obtained from the pregnant women in both groups.

EXAMINATION

General condition

Height, weight

Vital parameters- BP, PR, SpO2

Systemic examination- CVS, RS, CNS, Abdomen and spine

Airway assessment

INVESTIGATIONS

Complete blood count

Hemoglobin concentration

Renal function test

#blood urea

#serum creatinine

serum electrolytes

Random blood sugar

Urine routine

Bleeding time, Clotting time

Blood grouping and Typing

Electrocardiogram

Patients who satisfied the inclusion criteria were included in the study after explaining the procedure and nature of the study.

Written informed consent were obtained from all the parturients in their own language.

PATIENT PREPARATION

After the assessment of the parturient, under strict aseptic precautions, an 18 G intravenous cannula was started in the waiting room.

Parturients were premedicated with inj. Metoclopramide 10 mg IV and inj. Ranitidine 50 mg IV half an hour before surgery.

Parturients were kept in the left lateral position and shifted to the operation theatre. All parturients were pre loaded with 500mL of normal saline over a period of 15 minutes.

Baseline vitals such as blood pressure, pulse rate, oxygen saturation and fetal heart sounds were noted.

EQUIPMENTS

Autoclaved Spinal tray has been arranged with the following equipments for performing the combined spinal epidural technique.

1. 18 G hypodermic needle
2. 22 G hypodermic needle
3. 27 G spinal needle
4. 18 G epidural needle

5. 20 G epidural catheter
6. 2mL syringe
7. 5mL syringe
8. 5mL loss of resistance (LOR) syringe
9. Skin drape
10. Swabs
11. Chlorhexidine skin preparation solution
12. Betadine skin preparation solution
13. Sponge holding forceps

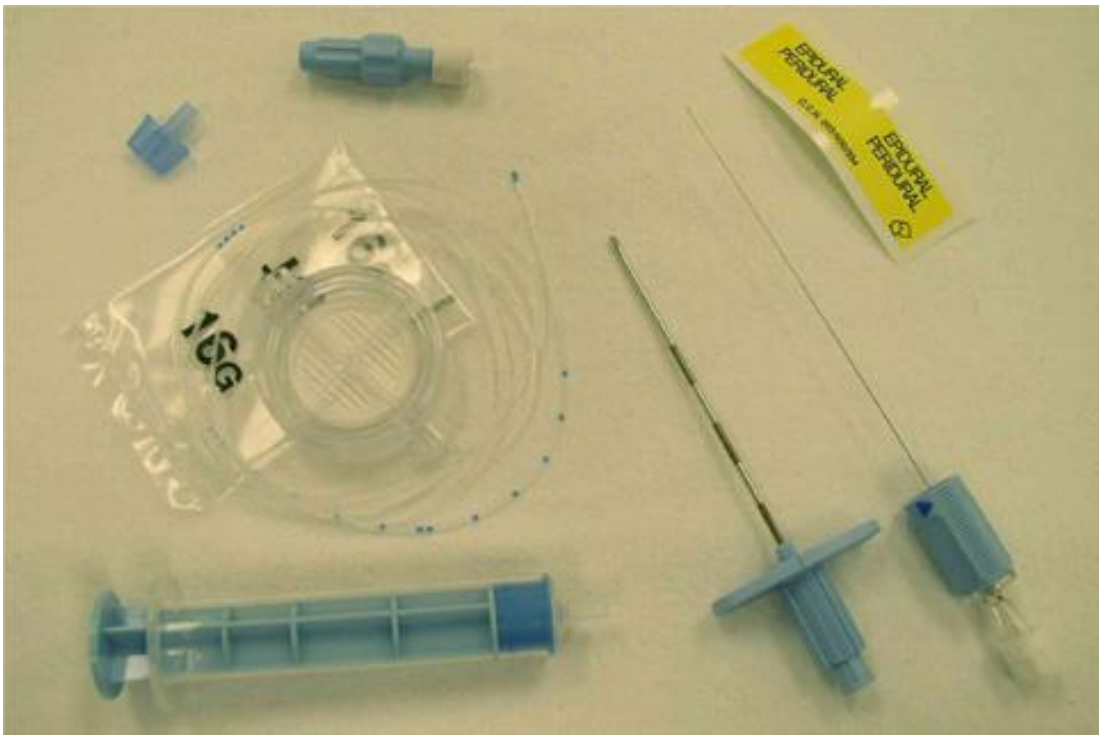

Fig 11. Combined spinal epidural set (Image courtesy: portexsafety.com)

DRUGS

1. 2% lignocaine solution for local infiltration

2. 0.5% hyperbaric bupivacaine

3. Fentanyl

PROCEDURE

The parturients were positioned laterally on a horizontal operating table. The back of the parturients was painted with betadine solution followed by chlorhexidine solution and finally wiped clean with dry gauze.

The painted area was draped with a sterile towel. L3-L4 interspace was identified and infiltrated with local anaesthetic (2mL of 2% lignocaine). Combined spinal epidural technique was planned to perform by needle through needle technique.18G epidural needle was inserted into L3-L4 space and epidural space was identified by the loss of resistance technique to air using an LOR syringe.

After the identification of epidural space, epidural needle is kept in position and 27 G spinal needle was inserted into the epidural needle reaching into the subarachnoid space ,then locked with the epidural needle at its provision for locking. After the free flow of CSF from the

spinal needle, 0.5% hyperbaric bupivacaine (1ml, 2ml each according to their allocated group) was injected at a rate of 0.2ml/second.

Following which the spinal needle was unlocked and removed, epidural catheter was threaded into the same L3-L4 interspace through the epidural needle into the epidural space and tip placed 5cm in cephalad direction. Epidural catheter was well secured with tapes.

The parturients were immediately turned on their back to supine position and a wedge is placed on the right side under gluteal region. For parturients allotted to group E, 6ml of 0.9% normal saline given through the epidural catheter at the 5^{th} minute of administration of spinal blockade. Parturients were given 6 liters of oxygen through hudson's face mask till the delivery of the baby. Necessary observations were noted.

PRIMARY OUTCOME MEASURES

VITAL SIGNS

Systolic and diastolic blood pressure, pulse rate, SpO2 were recorded for every 5 minutes for the first 30 mins , then every 10 mins for a period of upto 2 hours both intraoperatively and post operatively.

Hypotension is defined as fall in systolic blood pressure of more than 20% from the baseline values.

A heart rate of less than 60 beats/min defines Bradycardia

Parturientswho develop hypotension will be managed with bolus fluid administration and inj Ephedrine in 6mg increments intravenously.

Parturients who develop Bradycardia will be treated with inj.atropine intravenously.

SENSORY BLOCKADE

Sensory blockade level was assessed every 15 minutes from the 5^{th} minute of the initiation of spinal blockade by using loss of pin prick sensation in both groups.

MOTOR BLOCKADE

Motor blockade was assessed using Bromage scale.

Grade	**Criteria**	**Degree of Block**
I	Free movement of legs and feet	Nil (0%)
II	Just able to flex knees with free movement of feet	Partial (33%)
III	Unable to flex knees, but with free movement of feet	Almost Complete (66%)
IV	Unable to move legs or feet	Complete (100%)

SECONDARY OUTCOME MEASURES

NEONATAL APGAR SCORE

	Signs	0 Points	1 Point	2 points
A	Activity (Muscle Tone)	Absent	Arms and Legs Flexed	Active Movement
P	Pulse	Absent	Below 100 bpm	Above 100 bpm
G	Grimace (Reflex Irritability)	No Response	Grimace	Sneeze, cough, pulls away
A	Appearance (Skin Color)	Blue-gray, pale all over	Normal, except for extremities	Normal over entire body
R	Respiration	Absent	Slow, irregular	Good, crying

INCIDENCE OF COMPLICATIONS

Apart from hypotension, other complications such as nausea and vomiting, breakthrough pain intraoperatively were measured and compared between both the groups.

In case of breakthrough pain, analgesic supplementation was given with inj.pentazocine 0.5mg/kg IV. If not subsided, conversion to General Anaesthesia to be considered.

QUALITY OF SURGICAL ANAESTHESIA

Adequacy of muscle relaxation during the surgery in both groups were enquired from the surgeons.

OBSERVATION AND RESULTS

The study was conducted at Institute of Obstetrics and Gynaecology, Madras Medical College, Egmore. 60 parturients were enrolled in this prospective randomized study. The parturients were divided into 2 groups. Parturients in group E received 5mg of 0.5% hyperbaric bupivacaine plus 25mcg of fentanyl intrathecally followed by epidural volume extension with 6mL of normal saline through the epidural catheter. Parturients in group C received 10mg of 0.5% hyperbaric bupivacaine plus 25mcg of fentanyl intrathecally.

STATISTICAL ANALYSIS

Statistical analysis was done using SPSS software version 17.0.

If the P value is 0.000 to 0.010, it implies Highly significant

If the P value is 0.011 to 0.050, it implies significant

If the P value is 0.051 to 1.000 it implies Not Significant

DEMOGRAPHIC DATA

The two groups were comparable in respect to their age, weight and height. There was no statistical difference between the two groups.

Table 1. comparison of age, weight and height among the group C and group E

	Group	**N**	**Mean**	**Std. Deviation**	**P value**
Age in years	C	30	25.73	2.612	0.213
	E	30	24.80	3.112	
Weight	C	30	66.87	7.333	0.376
	E	30	64.97	9.076	
Height	C	30	159.90	5.598	0.153
	E	30	157.67	6.315	

Here the P values are greater than 0.05, hence the difference between age, weight and height of two groups are not significant.

BASELINE SYSTOLIC BLOOD PRESSURE

Baseline systolic blood pressure of both groups were comparable. There was no statistically significant difference between the two groups (P 0.137)

COMPARISON OF SYSTOLIC BLOOD PRESSURE AT VARIOUS INTERVALS AFTER THE INITATION OF BLOCKADE

The systolic blood pressure between the two groups at 5^{th},10^{th},and 15^{th} minutes after the administration of allotted amount of drugs for both group C and group E were found to be comparable.The P values respectively at 5^{th},$10^{th}$and 15^{th}minutes were 0.896, 0.299,0.287 . Hence the systolic blood pressure between the two groups were not statistically significant upto the 15^{th} min after the initiation of blockade.

Table 2. Comparison of systolic blood pressure at various intervals between the two groups

Following table shows the changes in SBP between two groups at various intervals.

	Group	N	Mean	Std. Deviation	Std. Error Mean	P value
SBP Baseline	C	30	124.17	4.857	.887	.137
	E	30	120.80	11.238	2.052	
SBP.5	C	30	114.87	5.532	1.010	.896
	E	30	114.57	11.212	2.047	
SBP.10	C	30	108.50	5.619	1.026	.299
	E	30	106.07	11.414	2.084	
SBP.15	C	30	102.37	6.145	1.122	.287
	E	30	104.83	10.980	2.005	
SBP.20	C	30	97.03	7.228	1.320	.001
	E	30	104.47	9.612	1.755	
SBP.25	C	30	93.70	8.318	1.519	.000
	E	30	103.90	10.571	1.930	
SBP.30	C	30	97.30	7.382	1.348	.002
	E	30	103.80	7.980	1.457	
SBP.40	C	30	101.70	7.363	1.344	.012
	E	30	107.07	8.670	1.583	
SBP.50	C	30	105.17	6.968	1.272	.062
	E	30	108.83	7.914	1.445	
SBP.60	C	30	108.03	4.923	.899	.063
	E	30	111.37	8.294	1.514	
SBP.90	C	30	110.60	3.490	.637	.063
	E	30	113.37	7.175	1.310	

Systolic blood pressures from the 20^{th} minute after the initiation of blockade were found to be significantly different between the two groups. When analysed it has been found that the systolic blood pressure in group C ,were significantly lower than that of group E from 20^{th} minute to 40^{th} minute after the initiation of blockade. The P values respectively were 0.001, <0.001, 0.002, 0.012 at 20^{th}, 25^{th} ,30^{th}, 40^{th} minutes.

After the 40^{th}minute , there were no significant difference in the systolic blood pressure measured between the two groups. The values were comparable, the P values respectively were 0.062, 0.063, 0.063 at 50^{th}, 60^{th}, 90^{th} minutes.

Thus the above table shows that significant difference in the systolic blood pressure exists between the groups from 20^{th} to 40^{th} minutes after the initiation of respective blockade in both groups.

COMPARISON OF DIASTOLIC BLOOD PRESSURE

Diastolic blood pressure between the two groups were found to be comparable in the baseline values and also at various intervals during the study. Diastolic blood pressure between the groups were not statistically different. Hence they were comparable.

Table 3. Comparison of diastolic blood pressure at various intervals between the 2 groups

The following table shows the diastolic blood pressure at various intervals in both groups

	Group	N	Mean	Std. Deviation	Std. Error Mean	
DBP Baseline	C	30	76.47	5.419	.989	.864
	E	30	76.83	10.373	1.894	
DBP.5	C	30	72.27	5.258	.960	.100
	E	30	69.40	7.766	1.418	
DBP.10	C	30	67.73	5.152	.941	.324
	E	30	65.43	11.563	2.111	
DBP.15	C	30	64.57	4.911	.897	.171
	E	30	61.60	10.656	1.946	
DBP.20	C	30	61.07	4.593	.839	.858
	E	30	61.43	10.183	1.859	
DBP.25	C	30	58.97	4.716	.861	.831
	E	30	58.53	10.037	1.832	
DBP.30	C	30	59.63	3.518	.642	.407
	E	30	58.07	9.645	1.761	
DBP.40	C	30	60.50	3.712	.678	.744
	E	30	61.13	9.906	1.808	
DBP.50	C	30	63.30	3.771	.688	.298
	E	30	65.57	11.196	2.044	

DBP.60	C	30	65.50	3.730	.681	.914
	E	30	65.70	9.392	1.715	
DBP.90	C	30	65.63	3.709	.677	.202
	E	30	67.63	7.641	1.395	

There were no significant difference in the diastolic blood pressure measured between the two groups. The P values measured at all the intervals were >0.05, hence we found that the diastolic blood pressure values were not statistically significant at any point during the study.

EPHEDRINE CONSUMPTION

Ephedrine , the amount of ephedrine consumed during study was compared between the two groups.

Out of total 60 parturients under study, ephedrine consumption (6mg) were found in more number of parturients in group C (n=12) than parturients in group E (n=5). Hence with a P value of 0.042, significant difference was found in consumption of ephedrine between two groups.

Table 4. Comparison of ephedrine consumption between the 2 groups

			Group		Total	P value
			C	E		
Ephedrine Consumption	0	Count	18	25	43	
		% within Ephedrine Consumption	41.9%	58.1%	100.0%	
		% within Group	60.0%	83.3%	71.7%	0.043
	6	Count	12	5	17	
		% within Ephedrine Consumption	70.6%	29.4%	100.0%	
		% within Group	40.0%	16.7%	28.3%	
Total		Count	30	30	60	
		% within Ephedrine Consumption	50.0%	50.0%	100.0%	
		% within Group	100.0%	100.0%	100.0%	

The above table shows the comparison of ephedrine consumption between the two groups.

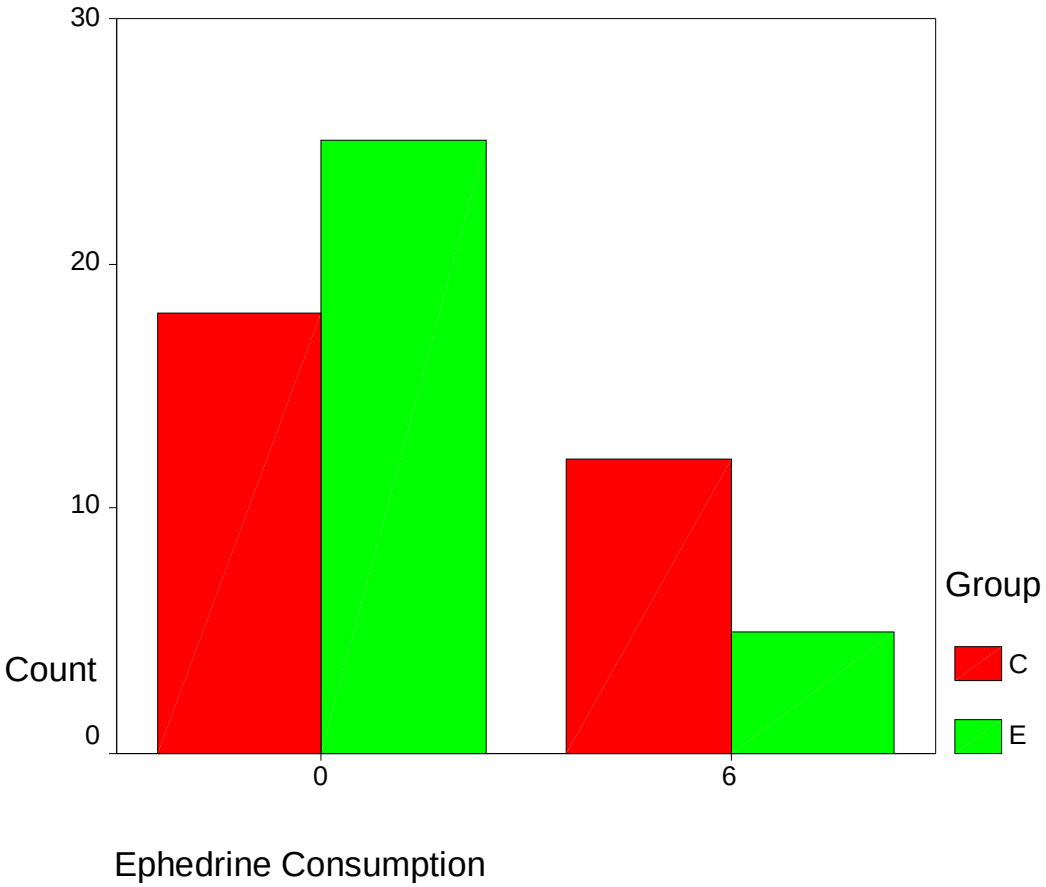

Fig:12 Ephedrine consumption between two groups.

Requirement of ephedrine to treat hypotension is seen in more number of group C than in group E parturients.

COMPARISON OF PULSE RATE AND DURATION OF STUDY

On comparison pulse rate between the two groups at various intervals during the study did not have much difference in their values. They were comparable. Duration of the surgery in both the groups were found to be similar.

Table 5. Comparison of duration of surgery between the 2 groups

	Group	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**	**P value**
Duration	C	30	60.67	4.498	.821	0.111
	E	30	58.17	7.130	1.302	

Hence from the P value obtained was 0.111, duration of the surgery between the two groups was not statistically significant.

COMPARISON OF SENSORY BLOCKADE

Level of Sensory blockade after the procedure had variety of observations at various intervals of time . Maximal level of sensory blockade (T4) achieved in both groups were similar. Time at which the maximal sensory blockade achieved (5-10 mins) in both groups were also of not much significance. Level of sensory blockade were checked every 15mins for a total of about 2 hrs.

Table 6. Comparison of Sensory blockade at various intervals after blockade between the two groups

Duration in mins		**T4 (Number of**	**T5 parturients**	**T6 at**	**T7 Various**	**T8 Study**	**T9 Intervals)**
SB 5th	C	30		0			
	E	26		4			
SB 15th	C	30					
	E	30					
SB 30th	C	18	10	2			
	E	28	0	2			
SB 45th	C	0	6	14	9	1	
	E	12	6	11	1	0	
SB 60th	C			2	8	11	9
	E			6	11	8	5

Duration in mins		T8	T9	T10	T11	T12	L1	L2	L3
SB 90	C	2	6	8	14	0			
	E	0	4	8	8	10			
SB120	C			2	5	10	13	0	0
	E			0	0	3	9	9	9

According to the above table , regression of sensory blockade level below T8, were noticed after 60 minutes post procedure in both group C and group E. Between the two groups,the number of parturientswhose sensory level regressed below T8,were more in group E than in group C. Hence as a whole the maximal level of sensory blockade achieved, time at which the maximal level is reached and progressive regression of sensory blockade levels at various intervals were not much significant between the two groups.

COMPARISON OF TIME FOR FIRST ANALGESIC REQUIREMENT AFTER SURGERY

Time at which the patient needed the first analgesic dose after the cesareansection is compared between the two groups. The following table suggests that the time for first analgesic requirement did not statistically differ between the two groups.

Table 7.comparison of time of first analgesic requirement after surgery between two groups

	Group	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**	**P value**
Time of 1st Analgesic Requirement after Surgery	C	30	155.17	6.884	1.257	0.078
	E	30	149.67	15.309	2.795	

The P value obtained in comparison of both groups is 0.078, hence it is not statistically significant.

COMPARISON OF MOTOR BLOCKADE

Motor blockade was measured using the modified Bromage scores ranging from 4 to 1. Maximum motor blockade achieved in both groups were 4, the time to attain the maximum motor blockade and time of motor blockade regression were compared between both groups. Motor blockade scoring is checked every 15 min upto a maximum of 2 hrs.

- At 5th min after the initiation of blockade, all parturients in both groups attained the maximum level of blockade. They were not significantly different.
- At 15th min after the initiation of blockade, no change in the level of blockade is noted in both groups. Hence there is no significant difference between them.

Table 8.comparison of motor blockade scoring between two groups from 5th min to 30th min (Bromage scoring of motor blockade)

Duration in mins	Groups	4	3	2	1
MB 5TH	C	30	_	_	_
	E	30	_	_	_

MB 15TH	C	30	_	_	_
	E	30	_	_	_
MB 30TH	C	30	_	_	_
	E	20	10	_	_

- At 30thmin , motor blockade level begins to regress in group E, but group C remains in the maximal level of blockade. significant difference is observed with P value of <0.001 (highly significant).
- From 45th min, regression of motor blockade level begins in group C also, but the speed of motor recovery is more faster in group E than in group C. P value is 0.009, hence the differences are statistically significant.

Table 9. comparison of motor blockade between 2 groups from 45th min to 120th min

Duration in mins	**Group**	**4**	**3**	**2**	**1**
MB 45TH	C	13	17	_	_
	E	5	25	_	_

MB 60TH	C	1	29	_	_
	E	_	13	17	_
MB 90TH	C	_	29	1	_
	E	_	1	16	13
MB 120TH	C	_	18	12	_
	E	_	_	2	28

- So at 120th min observation, nearly all parturients in group E (n=28) has reached the lowest level of motor blockade scoring, whereas none of the parturients in group C has reached the lowest score of 1. Differences between both groups in motor blockade regression was found to be highly significant with a P value of <0.001.

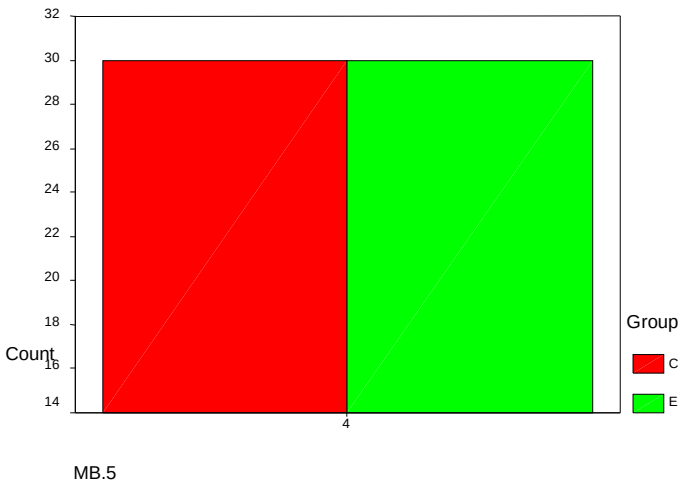

Fig .13 Motor blockade (Bromage 4) at 5th minute of the two groups

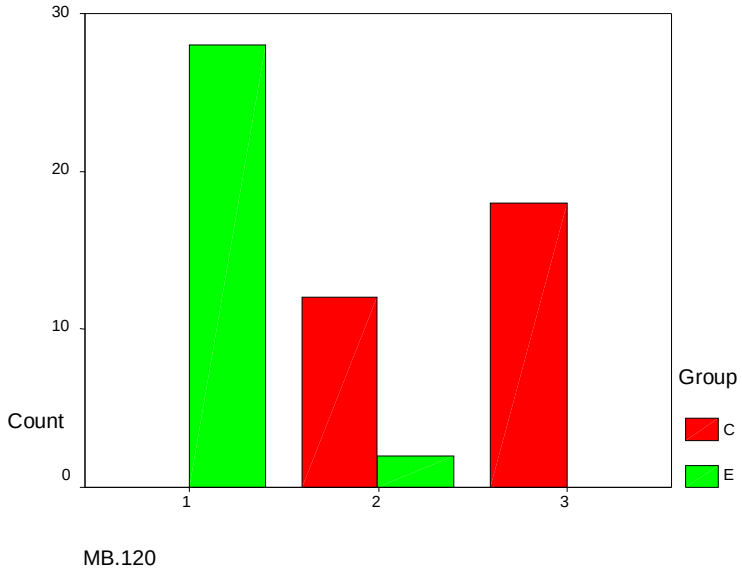

Fig .14 Bromage scores 1,2,3 at 120th minute in the two groups

NEONATAL SCORES COMPARISON

Neonatal scores between the two groups were compared by calculating the mean of APGAR scores measured at 1st and 5th min of life. P value obtained were 0.087, which denotes that the difference in the neonatal scores between the two groups was not significantly different.

Table 10.comparison of neonatal scores between the two groups

			Group		Total	P value
			C	E		
Neonatal Scores	7	Count	7	12	19	
		% within Neonatal Scores	36.8%	63.2%	100.0%	
		% within Group	23.3%	40.0%	31.7%	
	8	Count	17	17	34	
		% within Neonatal Scores	50.0%	50.0%	100.0%	0.087
		% within Group	56.7%	56.7%	56.7%	
	9	Count	6	1	7	
		% within Neonatal Scores	85.7%	14.3%	100.0%	
		% within Group	20.0%	3.3%	11.7%	
Total		Count	30	30	60	
		% within Neonatal Scores	50.0%	50.0%	100.0%	
		% within Group	100.0%	100.0%	100.0%	

Neonatal scores of all parturients in both groups were comparable.

OTHER VARIABLES

Complications such as nausea and vomiting, breakthrough pain were not seen in any of the patients in both group C and group E. There was no need of any analgesic supplementation for any of the parturients in both groups intraoperatively. The quality of muscle relaxation during surgery were rated by Surgeons as good for all the parturients in both groups. All these variables had been found to have no statistically significant difference between the group C and group E.

DISCUSSION

Nowadays cesarean section has become a preferred mode of delivery for some pregnant women. That too elective cesarean section for the safe and painless delivery has gained more attraction. Similarly the anaesthetic techniques in practice for cesarean section had also improvised a lot from olden days and it is continuing.

Among the various techniques practiced routinely in the society, spinal anaesthesia is considered to be the safest and most versatile technique. Here the patient can communicate and enjoy the birth of their baby.

The rapid onset and dense blockade made this technique a favourable one even during some of the emergency situations. But the sudden hypotension occurring after the spinal blockade, resulting in decrement of uteroplacental blood flow can be deleterious to the fetus inside uterus. As the uteroplacental circulation lacks Autoregulation, they are highly susceptible to the changes in the maternal circulation. Moreover the motor blockade occurring during spinal anaesthesia, remains for more than 3 hrs, making the newborn mother immmobilised. This may make them feel uncomfortable while feeding the baby .

Epidural anaesthesia for cesarean delivery,has certain advantages like lower incidence of hypotension and early mobility it has got more disadvantages which made their popularity to decline in its application for cesarean delivery. Some of the disadvantages are catheter related problems, quality of anaesthesia is inadequate, patchy blockade, increased chances for local anaesthetic toxicity due to administration of larger doses of drugs epidurally, not preferred in emergency situations.

Further advancements had let to the beginning of a newer technique , which was introduced by brownfield in 1981 combining both both spinal and epidural methods. This combined spinal epidural technique had the advantages of both the techniques. Presence of an Epidural catheter allows smaller dose of intrathecal Localanaesthetic to be given. This results in less incidence of hypotension, at the same time rapid onset of anaesthesia. If anaesthesia level seems to be inadequate , Local anaesthetic can be supplemented epidurally.

As there is decreased incidence of hypotension and provision for post operative pain relief, CSE is a more suitable technique in pregnant patients with associated cardiac conditions. Due to the advancements in all fields of medicine, now more and more women with congenital cardiac illnesses were able to overcome all the physiological changes in

pregnancy and coming for a safe confinement. Hence this technique is a boon in the practice of obstetric anaesthesia.

In this study we evaluate the effects of epidural volume extension using Normal saline through the epidural catheter after the administration of low dose intrathecal bupivacaine in providing adequate sensory blockade with less incidence of hypotension and a faster motor recovery.

Parturients of ASA I and ASA II Physical status are included in this study. Age, height and weight of pregnant women involved in this were comparable. Duration of the procedure, time from spinal blockade to supine positioning of the patient, and duration of the surgery were identical among both groups.

Baseline values of systolic and diastolic blood pressure, pulse rate, SpO2 were similar between both groups. Before the procedure all these patients were preloaded with 500ml of normal saline over a period of 15 mins.

Parturients in Group C received 10mg of hyperbaric bupivacaine 0.5% along with 25mcg fentanyl intrathecally without any epidural volume extension. Parturients in Group E received only 5mg of hyperbaric bupivacaine 0.5% along with 25mcg fentanyl intrathecally

with 6ml of normal saline given through epidural catheter as epidural volume extension.

HEMODYNAMIC CHANGES

The term hypotension is defined as decrease in systolic blood pressure of more than 20% from the baseline values.

A pulse rate of less than 60 beats /min is termed as bradycardia.

In 2006, a study conducted by Choi DH et al[13] , states that incidence of hypotension is lower in low dose combined spinal epidural than single shot spinal anaesthesia. In this study 10ml of 0.25% bupivacaine was given epidurally. In our study we have given 6ml of normal saline epidurally after a low dose intrathecal local anaesthetic (bupivacaine).

In the above mentioned study, lower incidence of hypotension was seen even with epidural administration of 0.25% bupivacaine, In our study also, there is a less incidence of hypotension in Parturients who received EVE in CSE compared to parturients who received only intrathecal local anaesthetic . The findings in our study was supported by this study .

A study was done by AshaTyogi et al[9], evaluating the effect of patient positioning (sitting and lateral) on epidural volume extensionand single shot spinal. This study had found no difference in the incidence of hypotension among the parturients given epidural volume extension and those who had been given single shot spinal. Similarly a study conducted by Mahmut Deniz GOKCE et al[19] evaluvating the effectiveness of epidural top up with saline in patients undergoing TURP, did not find any difference in incidence of hypotension. Study conducted by C.Loubert et al[14], also had the similar finding. But in our study incidence of hypotension was greater intraoperatively in the group C who received a routine dose of intrathecal bupivacaine compared with group E who received low dose of intrathecal bupivacaine along with epidural volume extension, which contradicts the findings from the above mentioned studies.

LEVEL OF SENSORY BLOCKADE

In 2000 Choi DH et al[12], conducted a study in which three groups, group 1,2,3 parturients planned for cesarean section were given 8mg of hyperbaric bupivacaine intrathecally alone, along with 10ml of saline and 10ml of 0.25% bupivacaine through epidural injection respectively. They found that the maximal level of sensory blockade achieved, degree of muscle relaxation were similar between groups 2 and 3.Group 1 ,parturients did not acquire adequate sensory level. They also found that the quality of surgical anaesthesia was Good in group 3 compared to groups 1 and 2.

But In our study also we compared the effects of giving 10mg of hyperbaric 0.5% bupivacaine intrathecally alone and 5mg of 0.5% bupivacaine intrathecally along with 6ml of normal saline through epidural catheter in two groups respectively. We didn't notice any difference in the maximal level of sensory blockade achieved, quality of blockade and the degree of muscle relaxation was good, none of the patients complained of breakthrough pain intraoperatively requiring analgesic supplementation.

Similarly a study conductedby C. Loubert et al[14] in 2011, He administered 7.5mg of intrathecal bupivacaine 0.5% for parturients in

group 1and 2, with group 2 receiving an additional 5ml of saline epidurally. Group 3 receiving 10mg of 0.5% intrathecal bupivacaine. The results obtained supported our study results with group 2 and 3, reaching a similar maximal height of sensory blockade than group 1. Other parameters were similar among all three groups with a minimal failure rate in group 3 comparatively.

Our results were further supported by the study done under AshaTyogi[9] in 2011, which compared the effects of position changes (sitting and lateral), while administration of both single shot spinal and epidural volume extension.In the groups which received single shot spinal anaesthesia, Maximal height of sensory blockade achieved was similar in both the lateral and sitting positions . But in the groups which received EVE along with spinal anaesthesia, it was found that the time to reach the maximal level of sensory blockade was earlier in lateral position than in sitting position. In our study, parturients received EVE in lateral position, and received a similar level of sensory blockade, as those who received only spinal anaesthesia even with a reduced dose of drug intrathecally.

A study by MahmutDeniz GOKCE et al[19], in which two group of patients posted for TURP were given 10mg of 0.5% bupivacaine

intrathecally with group one additionally receiving 10ml of saline epidurally. While group two received no epidural injection. Results obtained were maximal level of sensory blockade achieved was higher in group one than group two, which contradicts the results of our study, but here the same volume of intrathecal injection was given for both. This may be the reason for this difference.

A study conducted by AshaTyogi et al in 2014[10], on patients undergoing lower limb surgeries with inadequate sensory blockade, administration of epidural saline of 7ml had increasedthe level of sensory blockade.

Studies on the influence of lumbosacral CSF volume on the height of sensory blockade was conducted by Carpenter et al[11], in this study same volume of intrathecal lignocaine was administered in 10 volunteers and their CSF volume was measured by axial MRI, it was found that the lumbosacral CSF volume is the main factor determining the height of sensory blockade.

Similar study conducted by Higushi H et al[15], showed that the volume of lumbosacral CSF and its velocity has a inverse relationship with height of the sensory blockade and duration of the sensory blockade respectively.

Higushi H et al[16], also studied the influence of patient positioning over the lumbosacral CSF volume in determining the sensory block height, here in one group of patients,intrathecal bupivacaine was administered in lateral position whereas in other group thedrug was given in sitting position and patient remained in the sitting position for 2 mins, finally it was found that lumbosacral volume of CSF is the primary determinant of block height.

The results of the above study correlated with the proposed mechanism of our study. Normal saline administered epidurallyincreases the volume of epidural space which causes compression over the duralsac , resulting in narrowing of subarachnoid space, decreasing the volume of lumbosacral CSF, thereby increasing the height of sensory blockade even with a lower dose of drug administered intrathecally. This forms the basic mechanism behind our study producing an equivalent height of sensory blockade and muscle relaxation while decreasing the incidence of hypotension.

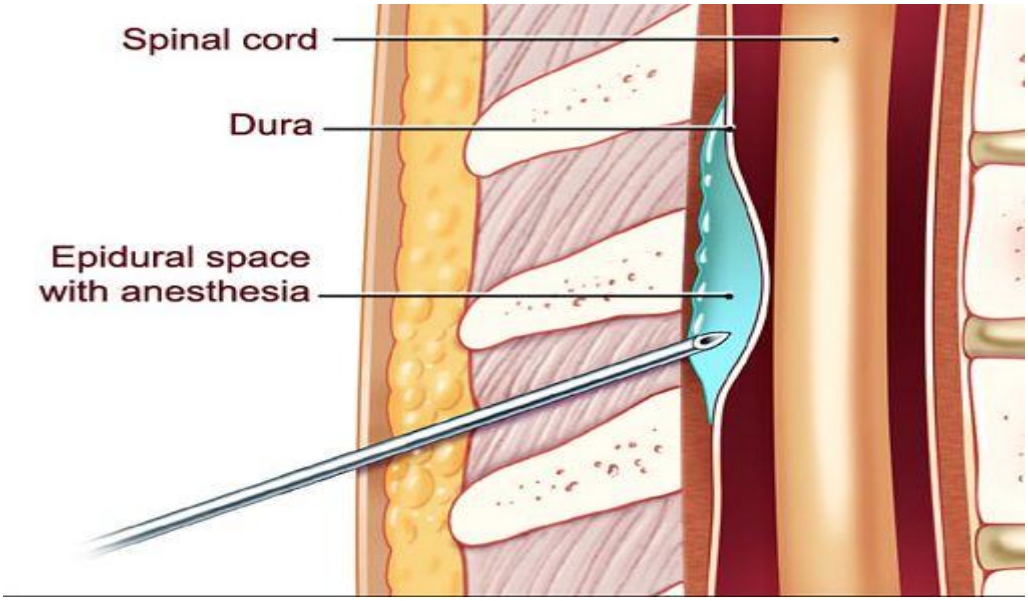

Fig . Mechanism of epidural volume extension.(Image courtesy: frca.co.uk)

MOTOR BLOCKADE RECOVERY

In the year 2004, Lew E et al[18], conducted a study comparing two groups of parturients, group one receiving 9mg of 0.5% bupivacaine intrathecally and group two receiving 5mg of 0.5% bupivacaine intrathecally along with 6ml of normal saline epidurally. Obtained results showed that the level of sensory blockade achieved and quality of blockade were similar in both groups, but the group two parturients showed a rapid recovery of motor blockade than group one.

This result correlates with the results of our study were group E parturients received similar doses as in the study above and found to have a faster motor recovery than the parturients in group C.

Other similar studies conducted by Choi DH et al[13], in which along with spinal bupivacaine of 6mg, 10ml of 0.25% bupivacaine was given epidurally and other group receiving 9mg of spinal bupivacaine found a faster motor recovery in the first group of pregnant women.

Study by C. Loubert et al[14], also had a similar result in his study of epidural volume extension with normal saline compared with single shot spinal bupivacaine given in term parturients planned for cesarean section.

EPHEDRINE CONSUMPTION

Inj.ephedrine, a mixed adrenergic agonist is used for treating hypotension intraoperatively in incremental doses of 6mg. Ephedrine consumption correlated well with the incidence of hypotension.

- Parturients in group C had higher incidence of hypotension , with 12 subjects involved in the study received a mean dose of 6mg of inj.ephedrine IV.
- Parturients in group E had a minimal incidence of hypotension compared to group C, in which only 5 subjects involved in study received 6mg of inj.ephedrine IV.

These results were supported by the results obtained from a study by Choi DH et al[13], where patients in the group receiving only spinal anaesthesia had a higher incidence of hypotension, thereby had an increased ephedrine comsumption than patients who received low dose combined spinal epidural anaesthesia.

NEONATAL APGAR SCORES

A study conducted by C. Loubert etal[14], compared the neonatal scores between the three groups who received intrathecal injection of 7.5mg of 0.5% bupivacaine in first two groups and third group receiving 10mg of 0.5% bupivacaine. Second group in addition to spinal, received 5ml of epidural normal saline . Neonatal apgar scores were found to be similar among all three groups.

This supports the results of our study in which the difference in the neonatal scores were not significant between the two groups.

OTHER VARIABLES

Variables like nausea and vomiting and breakthrough pain were not observed in any of our parturients under study during the intraoperative period.

Analgesic supplementation were not required by any of our parturientsintraoperatively.

Degree of motor blockade achieved and quality of muscle relaxation were similar in both the groups.

These results correlated with the results of the study conducted by C. Loubert et al[14], where all these parameters were compared between the three groups involved and found to have no difference among them.

Results of the study conducted by Choi DH et al[12], also found that the degree of motor blockade and muscle relaxation were similar among the groups , thus supporting the results of our study.

TIME OF FIRST ANALGESIC REQUIREMENT POSTOPERATIVELY

Time of first analgesic requirement indirectly measures the time taken for the regression of sensory blockade level completely and when the patients starts to perceive surgical pain postoperatively. Our study shows that there is no siginificant difference between the time for first analgesic requirement between the two groups.

These results were supported by the study conducted by Lew E et al[18], where he found that the time taken for regression of sensory blockade between the two groups were similar.

SUMMARY

This prospective randomized study was conducted in institute of obstetrics and gynecology, Madras Medical College, Chennai.

60 term parturients were enrolled in the study and were randomly allocated into one of the 2 groups comprising 30 in each. One group received epidural volume extension with 6mL of normal saline along with 5mg of 0.5% hyperbaric bupivacaine plus 25 mcg fentanyland the other group received only spinal anesthesia with 10mg of 0.5% hyperbaric bupivacaine plus 25 mcg fentanyl.

Haemodynamics, peak sensory block height, time of regression of sensory blockade, degree and duration of motor blockade, ephedrine consumption, neonatal scores, nausea, vomiting, time to first analgesic supplement required were noted and compared between the two groups.

Results were statistically analysed using SPSS software version 17.0.

Our study results show that the technique of epidural volume extension results in reduced dose requirement(upto 50% reduction) of intrathecal local anaesthetic to obtain the same level of sensory blockade as that of single shot spinal anaesthesia, maintenance of stable

haemodynamics, earlier regression of motor blockade which helps in earlier ambulation of the postpartum women.

Neonatal APGAR scores, time to requirement of first analgesic supplementation, nausea and vomiting were not significantly different between the two groups.

Hence Epidural volume extension in combined spinal epidural anaesthesia is a safe and viable alternative to routine single shot spinal anaesthesia for elective cesarean section.

CONCLUSION

It is concluded that epidural volume extension with normal saline in combined spinal epidural anaesthesia provides a hemodynamically stable anaesthesia with reduced duration of motor blockade without compromising the duration and quality of anaesthesia and with no adverse fetal effects, for elective cesarean section. These benefits are obtainable at a reduced dose of intrathecal local anaesthetic.

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INSTITUTE ETHICS COMMITTEE
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CERTIFICATE OF APPROVAL

To

Dr.C.Vanitha
Post Graduate M.D.(Anaesthesiology),
Madras Medical College, Chennai -3.

Dear Dr. Vanitha

Epidural volume extension in combined spinal epidural Anaesthesia in pregnant patients coming for Elective Cessarian section with routine spinal Anaesthesia - a comparative study" No.02092014.

1. Dr.C. Rajendran,MD	: Chairperson
2. Dr.V.Vimala,M.D. Dean,MMC,Chennai-3	: Deputy Chairperson
3. Prof.B.Kalaiselvi,M.D.,Vice-Principal,MMC,Ch-3	: Member Secretary
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11.Thiru S.Rameshkumar, Administrative Officer	: Lay Person
12.Thiru S.Govindasamy,BA.BL.	: Lawyer
13.Tmt.Arnold Sauline,M.A.MSW	: Social Scientist

We approve the proposal to be conducted in its presented in its presented form.

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any6 changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

Member Secretary, Ethics Committee

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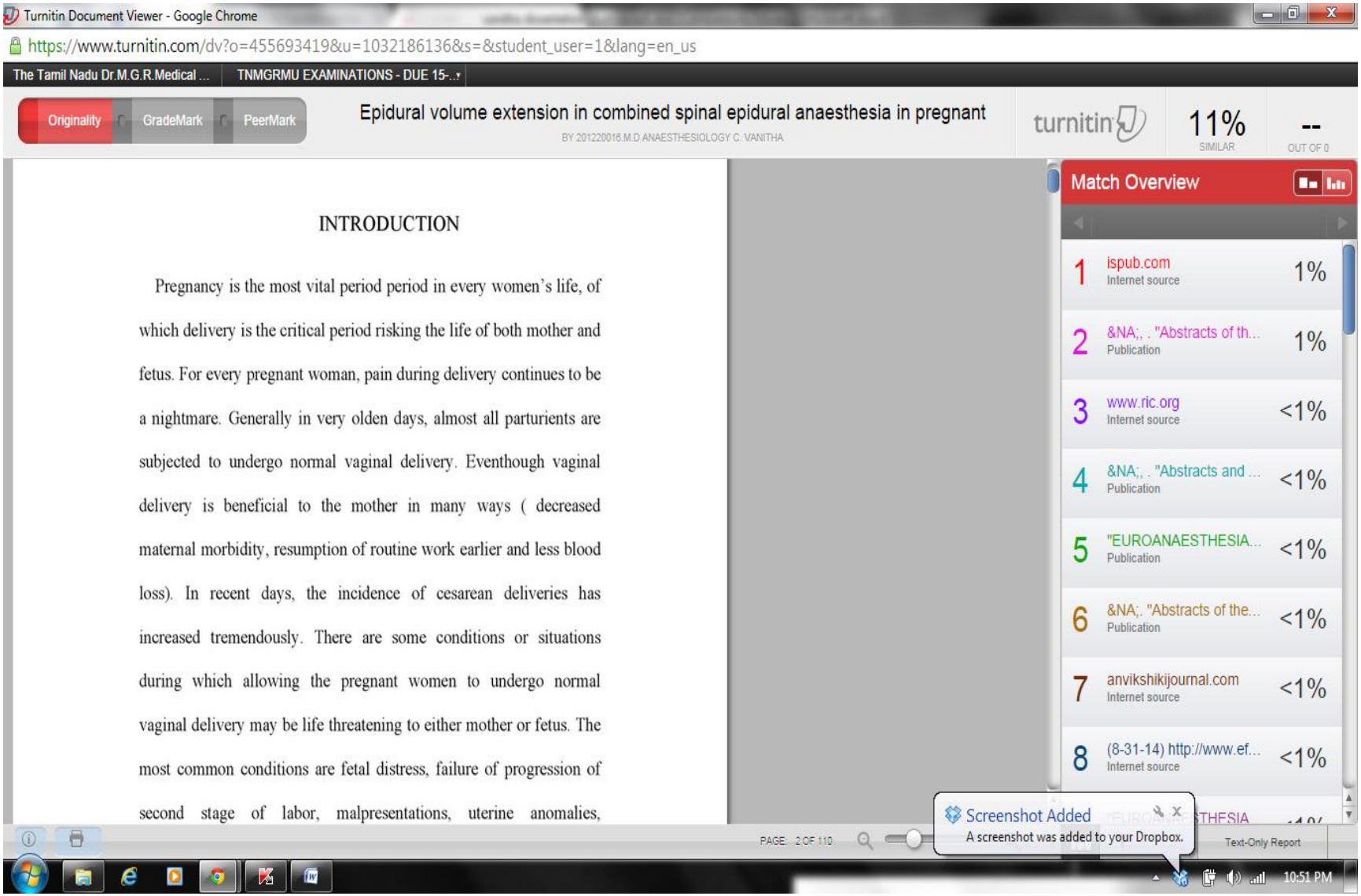
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INTRODUCTION
Pregnancy is the most vital period period in every women's life, of which delivery is the critical period risking the life of both mother and fetus. For every pregnant woman, pain during delivery continues to be a nightmare. Generally in very olden days, almost all parturients are subjected to undergo normal vaginal delivery. Eventhough vaginal delivery is beneficial to the mother in many ways (decreased maternal morbidity, resumption of routine work earlier and less blood loss). In recent days, the incidence of cesarean deliveries has increased tremendously. There are some conditions or situations during which allowing the pregnant women to undergo normal vaginal delivery may be life threatening to either mother or fetus. The most common conditions are fetal distress, failure of progression of second stage of labor, malpresentations, uterine anomalies,
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PROFORMA

IP NO : OBS H/O:
NAME : OBS PROC:
AGE : WT : kgs HT: cms

COMORBIDITIES : HT/DM/ASTHMA/EPILEPSY/OTHERS

ASAPS : I/II

PREOP VITALS : PR- /min BP- mmhg

SP02- IVF-

PROCEDURE : SAB / CSE

DETAILS :

EVENTS	**TIME**	**BP mmhg**	**PR/ min**	**IVF NS/RL**	**LEVEL OF BLOCKADE**	
					SENSORY	**MOTOR {mod.bromage scale)**

NEONATAL SCORES: Apgar

NAUSEA/VOMINTING: YES/NO

EPHEDRINE CONSUMPTION : YES/NO, if Yes_____mg/dl

BREAKTHROUGH PAIN: YES/NO

ANALGESIC SUPPLEMENTATION: YES/NO, if yes

SENSORY LEVEL AT 1hr_____,11/2hr_____, 2hr_____post op.

MOTOR LEVEL AT 1hr_____, 11/2hr_____, 2hr_____post op.

TIME OF FIRST ANALGESIC REQUIREMENT _____hrs after surgery.

INFORMATION SHEET

- You are eligible for this study
- We are conducting a study to compare the effects of two types of regional
- Anaesthesia given for elective lower segment cessarian section in Government hospital for obstretrics and gynecology and you may be benefitted by this
- The purpose of this study is to reduce the side effects of routinely used method of anaesthesia
- There are no additional side effects in this method and there wil be no harm for the health of mother and the baby in any way
- The privacy of the patients in the research will be maintained throughout the study. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared. Taking part in this study is voluntary. You are free to decide whether to participate in this study or to withdraw at any time; your decision will not result in any loss of benefits to which you are otherwise entitled The results of the special study may be intimated to you at the end of the study period or during the study if anything is found abnormal which may aid in the management or treatment.

Signature of investigator **Signature of Participant**

Date:

PATIENT CONSENT FORM

Study title : **Epidural volume extension in combined spinal epidural anaesthesia for elective cessarian section-A comparative study**

Study centre : Department of Anaesthesiology,
Institute of Obstretics and gynecology
Rajiv Gandhi Govt Hospital, Egmore,Chennai.

Participant name: Age: Sex: I.P.No:

I confirm that i have understood the purpose of procedure for the above study. i have the opportunity to ask the question and all my questions and doubts have been answered to my satisfaction.

I have been explained about the pitfall in the procedure. I have been explained about the safety,advantage and disadvantage of the technique.

I understand that my participation in the study is voluntary and that i am free to withdraw at anytime without giving any reason.

I understand that investigator ,regulatory authorities and the ethics committee will not need my permission to look at my health records both in respect to current study and any further research that may be conducted in relation to it, even if i withdraw from the study. I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from the study.

Time :

Date : Signature/thumb impression of patient

Place : Patient Name:

Signature of the Investigator

Name of the Investigator :C.Vanitha

GROUP E

S. No.	NAME	AGE	DIAGNOSIS	OBS.PROC	COMORBIDITI	WEIGHT	HEIGHT	ASA	PRELOAD	BASELINE SBP	BASELINE DBP	
										mmHg	mmHg	5th min
1	kalaiselvi	20	primi/breech	elective LSCS	nil	64	164	I	500ml NS	102	68	100
2	sumithra	24	prev LSCS	elective LSCS	nil	55	159	I	500ml NS	123	82	106
3	nadhiya	23	prev LSCS	elective LSCS	nil	60	164	I	500ml NS	108	67	101
4	Jayanthi	26	prev LSCS	elective LSCS	nil	63	155	I	500ml NS	123	84	118
5	Priyanka	20	oligohydramnios	elective LSCS	nil	76	155	I	500ml NS	130	96	123
6	Vasanthi	23	prev LSCS	elective LSCS	nil	62	163	I	500ml NS	131	94	125
7	Marthamm	24	CPD primi	elective LSCS	nil	63	150	I	500ml NS	127	78	125
8	Durgadevi	29	prev LSCS	elective LSCS	nil	74	158	I	500ml NS	99	52	100
9	Revathi	26	oligohydramnios	elective LSCS	nil	52	157	I	500ml NS	130	82	123
10	Ramisha	30	prev LSCS	elective LSCS	anemia	57	156	II	500ml NS	109	71	93
11	Sangeetha	20	prev LSCS	elective LSCS	nil	65	154	I	500ml NS	112	86	99
12	Santha	28	BOH	elective LSCS	anemia	62	164	II	500ml NS	132	86	125
13	Sadhana	28	prev LSCS	elective LSCS	nil	64	160	I	500ml NS	127	59	119
14	Rathiya	26	prev LSCS	elective LSCS	anemia	54	144	II	500ml NS	106	69	98
15	Thabibunis	24	prev LSCS	elective LSCS	nil	70	167	I	500ml NS	129	86	126
16	Gayathri	19	primi breech	elective LSCS	nil	69	167	I	500ml NS	137	76	128
17	Meena	27	prev LSCS	elective LSCS	anemia	75	152	II	500ml NS	99	69	114
18	Rohini	24	CPD primi	elective LSCS	nil	61	153	I	500ml NS	116	73	112
19	Padmavath	25	CPD primi	elective LSCS	nil	60	153	I	500ml NS	128	77	118
20	Vinodhini	22	CPD primi	elective LSCS	nil	79	157	I	500ml NS	128	77	127
21	Stella	30	CPD primi	elective LSCS	nil	85	165	I	500ml NS	119	66	110
22	Sairabanu	23	prev LSCS	elective LSCS	old TB	64	160	II	500ml NS	131	87	122
23	Sasikala	24	oligohydramnios	elective LSCS	anemia	62	160	II	500ml NS	123	79	112
24	Lavanya	23	breech	elective LSCS	anemia	54	145	II	500ml NS	121	76	121
25	Saranya	23	CPD primi	elective LSCS	nil	69	152	I	500ml NS	130	82	127
26	Kavitha	27	oligohydramnios	elective LSCS	nil	88	147	I	500ml NS	125	85	123
27	Rajeswari	24	prev 2 LSCS	elective LSCS	anemia	54	165	II	500ml NS	99	56	90
28	Bakyam	27	prev LSCS	elective LSCS	nil	66	162	I	500ml NS	127	77	121
29	Sumithra	24	prev LSCS	elective LSCS	nil	55	159	I	500ml NS	123	82	116
30	Yamuna	31	elderly primi	elective LSCS	nil	67	163	I	500ml NS	130	83	115

GROUP E

SBP AFTER INITIATION OF CSE(mmHg)									DBP AFTER INITIATION				
10th min	15th min	20th min	25th min	30th min	40th min	50th min	1hr	1.5 hr	5th min	10th min	15th min	20th min	25th min
77	99	101	107	108	92	97	107	115	62	52	49	49	52
110	108	104	107	111	115	114	121	122	72	71	66	76	64
105	100	99	105	95	112	115	112	116	62	76	58	63	66
118	119	118	118	113	121	115	123	119	72	91	81	78	80
117	111	102	99	106	117	123	129	129	82	80	76	63	50
116	104	102	103	106	111	117	129	126	65	62	52	53	52
82	92	103	111	106	105	120	98	113	72	50	50	58	50
98	86	80	93	88	96	103	106	105	60	47	57	57	53
115	106	101	94	96	93	94	99	112	76	82	57	52	52
90	88	100	92	93	94	98	101	103	65	60	54	60	59
103	107	110	106	110	110	108	109	113	56	63	55	56	60
121	128	115	125	109	109	110	119	117	74	82	87	80	87
103	110	97	99	102	110	112	108	111	62	59	52	42	48
100	102	99	95	100	105	110	108	99	61	54	61	67	52
103	114	117	101	102	113	107	117	119	71	60	63	53	52
107	101	106	96	99	102	111	114	108	72	70	57	53	54
94	97	95	79	96	99	100	98	101	74	60	63	62	54
100	99	95	92	87	106	102	106	103	76	52	63	54	51
118	116	121	124	119	118	118	115	113	72	84	74	87	78
107	90	115	110	109	113	119	116	112	62	51	52	58	56
107	105	105	104	102	94	96	111	114	60	62	63	55	56
115	119	117	109	110	109	111	104	108	72	67	61	66	50
100	95	92	97	106	103	107	106	111	76	49	54	51	53
114	123	117	120	118	127	121	112	118	82	76	86	74	70
118	110	112	108	114	111	107	109	115	79	71	69	70	68
112	110	107	111	103	109	113	121	120	67	63	57	66	59
88	90	89	87	95	96	99	102	105	52	60	47	57	53
119	98	111	110	100	111	103	114	120	75	67	50	59	53
109	121	106	110	108	104	107	115	118	79	72	67	68	71
116	97	98	105	103	107	108	112	116	72	70	67	56	53

GROUP E

OF CSE(mmHg)					PR AFTER INITIATION OF CSE									
30th min	40th min	50th min	1 hr	1.5 hr	BASELINE	5th min	10th min	15th min	20th min	25th min	30th min	40th min	50th min	1 hr
45	47	50	52	73	88	84	70	72	63	58	66	70	71	65
72	78	76	55	71	87	83	80	91	87	80	76	74	71	70
62	72	82	78	65	96	98	92	80	83	79	81	80	86	89
77	80	75	89	78	86	79	73	71	78	81	79	76	75	71
60	69	74	76	72	87	84	82	74	82	83	85	86	87	91
59	64	75	72	74	83	82	80	84	90	89	89	83	90	86
45	46	53	47	45	84	86	85	81	82	86	79	74	79	73
50	52	62	67	64	74	77	72	75	73	74	76	84	88	86
51	50	52	58	67	83	72	63	58	57	56	62	74	71	74
57	52	57	62	64	84	81	79	88	82	85	82	83	81	79
49	57	71	67	73	86	82	79	76	92	95	98	92	86	82
73	75	68	67	74	98	102	113	106	108	83	92	89	78	74
63	64	60	64	67	90	97	91	90	103	88	103	110	96	101
54	64	62	67	67	80	79	76	72	64	83	67	69	71	75
50	57	61	63	67	89	85	83	89	81	78	75	80	83	91
60	63	68	72	64	92	94	96	92	90	88	85	72	82	86
52	61	55	58	62	94	86	89	82	81	84	87	84	89	90
43	61	56	57	54	83	68	72	62	68	72	66	72	64	70
80	76	79	77	72	84	98	101	99	94	91	92	88	84	89
53	50	78	58	60	73	61	54	47	71	74	78	80	75	66
57	44	45	62	69	72	62	69	72	79	82	80	88	91	85
50	58	68	61	62	87	89	85	88	81	83	87	92	87	89
61	54	57	56	61	82	74	65	62	68	72	66	70	67	81
64	73	96	83	84	91	84	82	83	85	89	91	93	85	87
72	66	68	68	70	92	85	82	77	76	72	62	64	68	71
60	62	67	63	68	83	86	90	88	85	76	72	65	66	68
50	52	59	62	67	87	72	65	67	59	60	57	62	68	70
55	63	57	78	82	84	90	92	88	85	89	92	86	85	85
66	69	76	64	67	88	82	76	72	68	63	69	66	71	74
52	55	60	68	66	87	73	76	79	80	81	78	81	83	87

MASTER CHART- GROUP E (STUDY)

	IVF		SENSORY BLOCKADE AT							MOTOR BLOCKADE AT					
1.5 hr		5th min	15thmin	30thmin	45thmin	1hr	1.5 hr	2hrs	5thmin	15thmin	30thmin	45thmin	1hr	1.5 hr	2hrs
69	3	T4	T4	T4	T5	T8	T12	L3	4	4	4	3	3	2	1
75	3	T4	T4	T4	T5	T7	T12	L3	4	4	4	4	2	2	1
92	4	T6	T4	T4	T4	T6	T9	T12	4	4	4	3	3	2	1
72	3	T4	T4	T4	T6	T7	T10	L1	4	4	4	3	2	1	1
93	3	T6	T4	T4	T6	T8	T12	L2	4	4	4	3	2	1	1
88	3	T6	T4	T4	T6	T9	T12	L3	4	4	4	3	2	1	1
78	4	T4	T4	T4	T5	T8	T12	L2	4	4	4	3	2	1	1
88	3	T4	T4	T4	T6	T9	T12	L3	4	4	3	3	2	1	1
72	4	T4	T4	T4	T4	T7	T10	L1	4	4	4	3	2	1	1
72	3	T4	T4	T4	T6	T9	T11	L3	4	4	3	3	2	1	1
80	3	T4	T4	T4	T6	T8	T12	L3	4	4	3	3	2	1	1
75	3	T4	T4	T4	T4	T7	T11	L2	4	4	3	3	2	1	1
104	2	T4	T4	T4	T6	T9	T12	L3	4	4	3	3	2	1	1
79	3	T4	T4	T4	T4	T6	T10	L1	4	4	3	3	2	2	1
85	3	T4	T4	T4	T4	T6	T10	L2	4	4	4	3	3	2	1
87	4	T4	T4	T4	T4	T7	T10	L2	4	4	4	3	3	2	1
91	3	T4	T4	T4	T4	T6	T9	L1	4	4	4	3	2	1	1
61	3	T4	T4	T4	T4	T7	T11	L2	4	4	4	4	3	2	1
82	4	T4	T4	T4	T4	T6	T10	L2	4	4	4	3	3	2	1
72	3	T4	T4	T4	T4	T7	T11	L2	4	4	4	4	3	2	1
84	3	T4	T4	T4	T6	T8	T11	L3	4	4	3	3	2	1	1
93	2	T4	T4	T4	T4	T7	T11	L2	4	4	4	4	3	2	1
86	2	T4	T4	T4	T4	T6	T9	L1	4	4	4	3	2	1	1
88	4	T4	T4	T4	T6	T8	T12	L3	4	4	4	4	3	2	1
70	3	T4	T4	T4	T5	T7	T10	L1	4	4	4	3	2	2	1
72	3	T4	T4	T6	T6	T8	T11	L1	4	4	3	3	2	2	1
74	4	T6	T4	T4	T5	T7	T10	T12	4	4	4	3	3	2	2
82	3	T4	T4	T4	T6	T8	T11	L1	4	4	3	3	3	2	1
76	4	T4	T4	T6	T7	T9	T12	L1	4	4	3	3	3	2	1
84	3	T4	T4	T4	T5	T7	T9	T12	4	4	4	3	3	3	2

GROUP E

DURATION	NEONATAL SCORES	NAUSEA/VOMITING	EPHEDRINE CONSUMPTION	BREAKTHROUGH PAIN	ANALGESIC SUPPLEMENTATION
Minutes			mg		
50	8	no	6	no	no
65	8	no	0	no	no
65	7	no	0	no	no
55	8	no	0	no	no
60	8	no	0	no	no
50	7	no	0	no	no
60	7	no	0	no	no
50	9	no	6	no	no
65	7	no	0	no	no
50	8	no	0	no	no
50	7	no	0	no	no
55	7	no	0	no	no
55	7	no	0	no	no
50	8	no	0	no	no
65	8	no	0	no	no
75	8	no	0	no	no
55	7	no	6	no	no
60	8	no	6	no	no
65	7	no	0	no	no
60	8	no	6	no	no
60	7	no	0	no	no
50	8	no	0	no	no
45	8	no	0	no	no
70	8	no	0	no	no
55	8	no	0	no	no
65	7	no	0	no	no
60	8	no	0	no	no
55	8	no	0	no	no
65	7	no	0	no	no
60	8	no	0	no	no

GROUP E

TIME OF 1ST ANALGESIC REQUIREMENT AFTER SURGERY
Minutes
150
135
180
140
135
120
150
135
140
150
140
150
140
135
150
135
160
180
160
150
150
180
180
150
140
135
160
145
155
160

GROUP C

S.NO	NAME	AGE	DIAGNOSIS	OBS.PROC	COMORBIDITIES	WEIGHT	HEIGHT	ASA	PRELOAD	BASELINE SBP
1	Lynn mary	30	cpd	elective LSCS	nil	91	160	I	500ml NS	130
2	soundarya	25	prev LSCS	elective LSCS	nil	67	165	I	500ml NS	123
3	Rathinam	26	oligohydramnios	elective LSCS	nil	72	169	I	500ml NS	119
4	Kalyani	21	cpd	elective LSCS	nil	56	154	I	500ml NS	125
5	kousalya	26	prev LSCS	elective LSCS	anemia	66	168	II	500ml NS	131
6	gowri	24	prev LSCS	elective LSCS	nil	58	162	I	500ml NS	125
7	saraswathi	26	oligohydramnios	elective LSCS	asthmatic	59	157	II	500ml NS	129
8	kamatchi	25	prev LSCS	elective LSCS	nil	62	165	I	500ml NS	127
9	monika	27	prev LSCS	elective LSCS	nil	66	167	I	500ml NS	127
10	gomathi	26	prev LSCS	elective LSCS	nil	62	159	I	500ml NS	126
11	karpagam	25	oligohydramnios	elective LSCS	nil	83	167	I	500ml NS	112
12	valli	22	cpd	elective LSCS	nil	67	156	I	500ml NS	127
13	selvi	31	elderly primi	elective LSCS	nil	68	165	I	500ml NS	129
14	hamsaveni	24	prev LSCS	elective LSCS	nil	65	161	I	500ml NS	121
15	shobana	29	cpd	elective LSCS	nil	72	154	I	500ml NS	115
16	priyanka	26	prev LSCS	elective LSCS	nil	68	165	I	500ml NS	124
17	shanthi	23	prev LSCS	elective LSCS	nil	59	160	I	500ml NS	116
18	saratha	27	prev LSCS	elective LSCS	nil	66	168	I	500ml NS	127
19	kavipriya	25	prev LSCS	elective LSCS	nil	59	162	I	500ml NS	118
20	tamilselvi	26	oligohydramnios	elective LSCS	nil	61	165	I	500ml NS	125
21	ranjitham	29	prev LSCS	elective LSCS	nil	65	166	I	500ml NS	121
22	kalyani	28	oligohydramnios	elective LSCS	asthmatic	78	167	II	500ml NS	128
23	sornam	25	cpd	elective LSCS	nil	66	146	I	500ml NS	121
24	sumathi	27	prev LSCS	elective LSCS	nil	72	166	I	500ml NS	127
25	savithri	22	cpd	elective LSCS	nil	64	149	I	500ml NS	129
26	harini	23	prev LSCS	elective LSCS	nil	65	167	I	500ml NS	125
27	fathima	22	prev LSCS	elective LSCS	nil	68	164	I	500ml NS	127
28	gisha	31	elderly primi	elective LSCS	nil	65	159	I	500ml NS	117
29	yamuna	24	oligohydramnios	elective LSCS	nil	71	165	I	500ml NS	126
30	ajeerabee	27	prev LSCS	elective LSCS	nil	65	159	I	500ml NS	128

GROUP C

BASELINE DBP		SBP AFTER INITIATION OF BLOCKADE										DBP AFTER
	5th min	10th min	15th min	20th min	25th min	30th min	40th min	50th min	1hr	1.5hr	5th min	10thmin
76	121	113	108	94	85	103	116	113	117	109	76	65
72	109	105	102	96	92	102	105	104	112	111	67	63
72	103	105	92	88	91	97	105	109	111	114	71	69
78	114	108	101	102	96	92	98	104	108	110	78	72
84	124	114	109	104	95	87	102	116	111	109	81	79
76	116	104	101	93	90	95	100	103	108	110	71	68
78	120	113	103	93	84	98	105	109	111	115	75	70
76	114	107	101	94	88	84	92	99	105	109	76	61
75	120	115	108	104	100	103	109	113	111	115	75	73
77	116	109	105	100	95	99	97	102	105	113	76	71
67	103	100	96	86	82	94	96	102	104	106	65	59
82	118	107	100	101	104	103	109	111	114	112	69	63
88	119	108	100	94	87	101	105	112	116	112	83	78
75	112	108	103	100	96	104	111	108	106	114	71	69
72	108	100	93	83	79	88	92	101	107	111	71	64
76	117	109	110	105	101	103	106	109	113	116	72	69
73	110	95	91	87	80	89	97	100	106	111	70	65
82	117	109	105	100	96	99	103	107	109	111	78	72
73	106	102	94	88	91	101	104	110	114	111	63	60
84	108	101	94	86	80	93	101	104	108	106	70	65
78	115	107	104	100	103	108	114	111	113	110	72	68
76	117	108	101	96	92	88	85	95	103	115	71	66
74	116	110	95	91	101	109	111	114	108	112	71	68
82	119	115	110	106	108	102	98	99	100	104	75	70
84	117	113	111	109	107	105	101	103	100	106	78	75
76	120	117	113	107	104	102	106	110	109	115	72	70
74	121	118	107	103	95	88	100	102	105	110	72	67
64	109	105	100	94	88	82	97	101	106	111	60	61
68	119	115	110	107	104	106	100	103	106	109	63	60
82	118	115	104	100	97	94	86	81	95	101	76	72

GROUP C

GROUP C

INITIATION OF BLOCKADE								BASELINE PR		PR AFTER INITIATION OF BLOCKADE			
15thmin	20thmin	25thmin	30thmin	40thmin	50thmin	1hr	1.5hr		5thmin	10thmin	15thmin	20thmin	25thmin
67	56	53	64	66	71	72	69	90	88	75	76	66	64
59	57	60	58	61	59	64	66	84	80	71	65	62	58
60	56	59	61	57	59	63	60	93	83	79	75	63	62
67	66	61	59	60	61	67	71	88	82	76	71	68	61
72	62	59	54	61	67	64	68	71	85	81	75	72	69
63	62	60	59	62	64	68	66	87	80	75	73	71	68
67	63	56	59	61	66	69	71	88	74	76	71	68	63
63	60	55	52	61	64	62	65	95	91	87	77	73	65
68	62	60	58	61	63	62	59	85	80	73	71	74	68
68	62	61	59	61	63	67	60	89	83	77	73	68	63
53	51	52	58	62	66	69	67	88	81	76	72	68	62
66	59	61	57	54	60	63	65	97	90	85	83	86	79
73	70	69	63	66	69	71	68	101	95	91	80	73	79
62	67	59	62	57	61	66	68	75	72	67	66	69	62
61	57	50	57	64	68	61	66	78	71	69	66	59	55
64	66	61	59	65	69	73	75	83	81	76	79	73	68
61	58	54	61	67	70	73	71	88	81	74	72	68	66
74	67	63	65	66	61	68	70	79	70	63	68	61	64
58	61	62	59	64	66	68	64	89	82	76	77	71	69
62	58	54	59	60	62	66	64	92	88	83	78	67	62
66	61	63	67	62	60	64	62	73	71	67	63	66	61
62	57	53	56	54	64	62	65	92	85	80	76	72	68
64	66	62	60	58	56	61	63	76	73	69	64	61	64
68	66	63	61	59	60	63	65	78	72	70	66	62	68
71	67	69	65	61	64	67	64	76	69	65	71	73	62
68	63	60	59	57	62	65	61	86	82	76	73	71	69
64	61	63	66	59	62	60	63	78	72	69	66	64	61
58	53	51	55	58	60	61	64	88	81	76	73	69	67
59	56	58	61	59	64	62	66	79	73	69	65	64	61
69	62	58	56	52	58	64	63	77	72	70	69	64	68

GROUP C

					IVF	SENSORY BLOCKADE AT						
30thmin	40thmin	50thmin	1hr	1.5hr		5th min	15thmin	30thmin	45thmin	1hr	1.5hr	2hrs
68	63	64	66	70	3	T4	T4	T4	T6	T8	T11	L1
59	63	61	64	67	4	T4	T4	T4	T5	T7	T10	T12
59	55	59	63	68	3	T4	T4	T4	T6	T7	T11	L1
64	65	61	63	62	3	T4	T4	T5	T6	T8	T10	T12
63	65	59	61	64	4	T4	T4	T4	T6	T9	T11	L1
62	61	63	68	70	3	T4	T4	T5	T7	T9	T11	L1
60	57	61	65	68	3	T4	T4	T4	T6	T8	T10	T12
61	56	59	64	66	4	T4	T4	T4	T5	T6	T8	T10
66	64	61	60	62	3	T4	T4	T5	T7	T9	T11	L1
60	62	68	62	63	4	T4	T4	T4	T6	T8	T11	L1
60	68	64	66	68	4	T4	T4	T4	T6	T8	T10	T12
73	71	74	72	70	3	T4	T4	T5	T7	T9	T11	L1
80	73	70	74	76	4	T4	T4	T4	T6	T7	T9	T11
59	61	63	68	71	3	T4	T4	T4	T7	T9	T11	L1
58	63	66	64	67	3	T4	T4	T4	T5	T7	T9	T11
63	60	63	67	66	4	T4	T4	T5	T7	T9	T11	L1
61	64	67	61	65	3	T4	T4	T4	T6	T8	T11	L1
65	68	66	70	73	4	T4	T4	T4	T5	T8	T10	T12
74	69	67	70	72	3	T4	T4	T5	T6	T8	T10	T12
57	51	59	60	63	4	T4	T4	T4	T6	T7	T9	T11
62	68	71	65	62	4	T4	T4	T5	T7	T9	T11	L1
63	66	71	69	74	4	T4	T4	T4	T6	T7	T9	T12
72	70	64	61	62	3	T4	T4	T6	T7	T9	T11	T12
61	67	65	59	62	3	T4	T4	T5	T7	T8	T11	L1
67	65	61	60	64	4	T4	T4	T6	T8	T9	T11	L1
66	64	68	63	67	4	T4	T4	T4	T5	T6	T8	T10
63	67	64	66	69	4	T4	T4	T4	T6	T7	T9	T11
64	61	60	63	64	4	T4	T4	T5	T7	T8	T10	T12
67	64	69	70	67	3	T4	T4	T4	T5	T7	T9	T11
62	58	61	60	62	4	T4	T4	T5	T6	T8	T10	T12

GROUP C

MOTOR BLOCKADE AT							DURATION	NEONATAL SCORES	NAUSEA/VOMITING
5thmin	15thmin	30thmin	45thmin	1hr	1.5hr	2hrs			
4	4	4	4	4	3	3	65	7	no
4	4	4	4	3	3	3	70	8	no
4	4	4	3	3	3	3	60	8	no
4	4	4	3	3	3	3	65	8	no
4	4	4	4	3	3	3	70	9	no
4	4	4	3	3	3	2	60	8	no
4	4	4	3	3	3	3	65	9	no
4	4	4	4	3	3	3	70	7	no
4	4	4	3	3	3	3	65	8	no
4	4	4	3	3	3	2	70	8	no
4	4	4	3	3	2	2	65	8	no
4	4	4	4	3	3	3	60	9	no
4	4	4	3	3	3	2	65	7	no
4	4	4	4	3	3	3	65	8	no
4	4	4	4	3	3	3	55	8	no
4	4	4	3	3	3	2	65	8	no
4	4	4	4	3	3	3	70	7	no
4	4	4	3	3	3	2	60	8	no
4	4	4	4	3	3	3	65	8	no
4	4	4	3	3	3	2	60	9	no
4	4	4	3	3	3	2	65	7	no
4	4	4	4	3	3	3	60	8	no
4	4	4	3	3	3	2	65	9	no
4	4	4	4	3	3	3	70	8	no
4	4	4	3	3	3	2	75	8	no
4	4	4	4	3	3	3	60	8	no
4	4	4	3	3	3	2	65	7	no
4	4	4	3	3	3	3	60	9	no
4	4	4	3	3	3	2	55	8	no
4	4	4	4	3	3	3	80	7	no

GROUP C			GROUP C
EPHEDRINE CONSUMPTION	BREAKTHROUGH PAIN	ANALGESIC SUPPLEMENTATION	TIME OF 1ST ANALGESIC REQUIREMENT AFTER SURGERY
6	no	no	165
0	no	no	150
0	no	no	155
0	no	no	140
6	no	no	155
0	no	no	145
6	no	no	140
0	no	no	155
0	no	no	160
0	no	no	145
6	no	no	155
0	no	no	150
6	no	no	160
0	no	no	155
6	no	no	165
0	no	no	160
6	no	no	155
0	no	no	155
0	no	no	160
6	no	no	155
0	no	no	155
6	no	no	165
0	no	no	145
0	no	no	155
0	no	no	160
0	no	no	155
6	no	no	155
6	no	no	160
0	no	no	165
6	no	no	160